MP MASTER
MA35035

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About This Manual

Composition of operation manual:

The operation manual of the MP1776A Error Detector is composed of the following two manuals. Use the manuals matching the usage objective.

- MP1776A Error Detector operation manual:
  Describes the outline, specifications, preparation before use, panel layout, setup, screen layout, operation, measurement examples, and performance test of the MP1776A and MU177601B 12.5 Gb/s error detector.

- MP1776A Error Detector remote control operation manual:
  Describes the remote control commands of the standard RS-232C and optional GPIB interfaces, and program examples.

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1.1 Product Overview

The MP1776A Error Detector (referred to as "MP1776A" hereafter) enables measurement at an operation frequency from 100 MHz to 12.5 GHz by inserting the MU177601B 12.5 Gb/s Error Detector (referred to as the "ED unit" hereafter) to a slot. The MP1776A is used to evaluate various digital communication devices, modules such as O/E and E/O, and digital ICs, and is suitable for research and development.

Features

- A unit configuration offering high expandability
  ED units can be inserted into Slots 1 to 4. Because of a variable number of inserted units and slot positions, the system form can be selected by the combination. In addition, a future upgrade can be easily possible with an expansion slot available at Slot 5.
- Three kinds of measurement modes
  The following three measurement modes can be selected by combining ED units:
  - Independent Mode: This is an independent measurement using each ED. A maximum of 4 units can be used, independently.
  - 2CH Combined: This is a measurement with correlation between 2 EDs: the combination of ED1 and ED3 and the combination of ED2 and ED4. This mode with DEMUX equipment enables the measurement frequency up to 25 GHz equivalent.
  - 4CH Combined: This is a measurement with correlation between 4 EDs. This mode with DEMUX equipment enables the measurement frequency up to 50 GHz equivalent.
- Analysis of continuous signal and burst signal
  Bit errors can be measured for both continuous signal and burst signal.
- Many patterns applicable to various systems
  PRBS (2^N–1: N = 7 to 31), PRGM (8 Mbits/CH: in the Independent mode), and Zero-Subst pattern.
- User-friendly
  By using the MP1776A with Microsoft ® Windows ® operating system Version 3.1 and the large-size LCD color screen, applications are easier to be understood and operated.
- Saving/recalling large quantities of data
  FDD and HDD are built into the MP1776A as storage devices enabling the saving/recalling of the setting information.
- Various external interfaces supported
  RS-232C (standard) and GPIB (Option 01) are supported as remote control interfaces.

1.2 Composition of Operation Manual

This operation manual consists of 9 sections, appendix, and index, as shown in the following table:

Section numbers	Description
Section 1 Overview	Product overview, composition of operation manual, MP1776A configuration, and specifications
Section 2 Preparation Before Use	Environmental conditions for installation, safety measures, and preparation before power on
Section 3 Panel Explanation and Connection	Explanation of main body panel keys, LEDs, and setup and their functions.
Section 4 Screen Explanation	Screen configuration and operation
Section 5 Operation	Operation for each function
Section 6 Measurement Example	Measurement example using the MP1776A
Section 7 Performance Test	Performance test explanation
Section 8 Maintenance	Preventive maintenance for safety, daily service, calibration, storage, and transportation
Section 9 Disposal	Disposal cautions
Appendix	Initial setting at factory shipment, troubleshooting, and glossary
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1.3 MP1776A Configuration

1.3.1 Standard configuration

The standard configuration of the MP1776A is shown in the following table:

Table 1-1 MP1776A standard configuration

Item	Model name/Code	Product name	Quantity	Remarks
Instrument	MP1776A	Error Detector	1	
Attachment	J0491	Power cord with shield	1	13 A
	F0074	10-A fuse	1	For 100 Vac or 200 Vac
	W1410AE	MP1776A operation manual	1	
	W1411AE	MP1776A remote-control operation manual	1	
	Z0319A	PS/2 mouse	1	
	Z0320	Input pen	1	
	Z0352	MP1776A recovery tool	1 set	
	Z0396A	Pen Holder	1	
	Z0306A	Wrist strap	1	

Table 1-2 MU177601B standard configuration

Item	Model name/Code	Product name	Quantity	Remarks
Instrument	MU177601B	12.5 Gb/s Error Detector	1	
Attachment	J0696B	Coaxial cable 80 cm	2	With SMA plug at both ends
	J0693A	Coaxial cable 1.0 m	1	With SMA plug at both ends

1.3.2 Unit configuration

The plug-in unit usable for the MP1776A is shown in the following table:

Table 1-3 Unit configuration

Model name/Code	Product name	Remarks
MU177601B	12.5 Gb/s Error Detector	Error detector applicable to burst operation frequency of 100 Mb/s to 12.5 Gb/s.

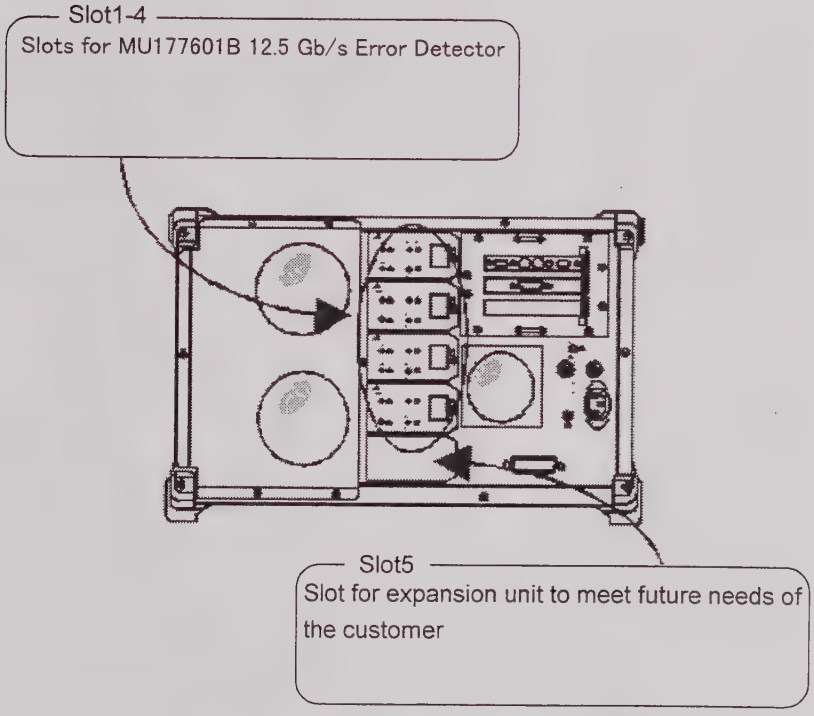


Fig. 1-1 Unit configuration

1.3.3 Option configuration

The option for the MP1776A is shown in the following table:

Table 1-4 Option configuration

Model name/Code	Product name	Remarks
MP1776A*01	GPIB	GPIB interface board

1.3.4 Applicable parts

Applicable parts for the MP1776A are shown in the following table:

Table 1-5 Applicable parts

Model name/Code	Product name	Remarks
Z0321A	Keyboard	PS/2
J0008	GPIB connection cable	2.0 m, 408JE-102

1.4 Specifications

Specifications for the MP1776A are shown in Table 1-6.

The * mark indicates that option shown outside of the column must be installed.

Table 1-6 Specifications (1/6)

Item			Specifications
Operation frequency			0.1 to 12.5 GHz
Measurement pattern	PRBS	Pattern length	2^N-1 (N = 7, 9, 11, 15, 20, 23, 31)
	Zero-Subst		The continued-zero pattern can be set up to pattern length minus 1. Pattern: 2^N (N = 7, 9, 11, 15)
	PRGM	Data length	(Independent): 2 to 65536 1-bit step 65536 to 131072 2-bit step 131072 to 262144 4-bit step 262144 to 524288 8-bit step 524288 to 1048576 16-bit step 1048576 to 2097152 32-bit step 2097152 to 4194304 64-bit step 4194304 to 8388608 128-bit step (2CH Combined): 4 to 131072 2-bit step 131072 to 262144 4-bit step 262144 to 524288 8-bit step 524288 to 1048576 16-bit step 1048576 to 2097152 32-bit step 2097152 to 4194304 64-bit step 4194304 to 8388608 128-bit step 8388608 to 16777216 256-bit step (4CH Combined): 8 to 262144 4-bit step 262144 to 524288 8-bit step 524288 to 1048576 16-bit step 1048576 to 2097152 32-bit step 2097152 to 4194304 64-bit step 4194304 to 8388608 128-bit step 8388608 to 16777216 256-bit step 16777216 to 33554432 512-bit step
	Logic inversion		Positive/Negative can be switched

Table 1-6 Specifications (2/6)

Item			Specifications
Synchronization method		Normal	Valid when the measurement pattern is Zero-Subst or PRGM.
		Frame	Valid when the measurement pattern is Zero-Subst or PRGM and the data length is 128 bits or more. Frame bit length: 8 to 32 bits / 8-bit step (Independent) 16 to 64 bits / 16-bit step (2CH Combined) 32 to 128 bits / 32-bit step (4CH Combined) Effective data length: Data length ≥128 bits (Independent) Data length ≥ 256 bits (2CH Combined) Data length ≥ 512 bits (4CH Combined)
Receiving mode			Repeat/External-burst modes External burst: Synchronized with the external Resync signal.
Measurement mode			Independent/2CH Combined/4CH Combined Independent: Settings and measurements are independently made for each ED. 2CH Combined: Settings and measurements are made to correlate between 2 EDs. 4CH Combined: Settings and measurements are made to correlate among 4 EDs. Combination of units: The combination of ED units correlated in the Combined Mode At 2CH Combined mode: ED1 and ED3, ED2 and ED4 At 4CH Combined mode: ED1, ED2, ED3, and ED4 In the Combined modes above, there are no mixed of the units in the correlation status and in the independent status.
Measurement	Measurement item	Error detection mode	Insertion/Omission/All
		Error rate	0.0000×10^{-16} to 1.0000×10^{-0}
		Number of errors	0 to 9,999,999 and 1.0000×10^{7} to 9.9999×10^{16}
		EI (Asynchronous)	0 to 9,999,999 and 1.0000×10^{7} to 9.9999×10^{16} Interval: 10 ms, 100 ms, 1s
		%EFI (Asynchronous)	0.0000 to 100.0000%
		Frequency	0.1 to 50 GHz (Resolution 1 kHz/Accuracy 10 ppm ±1 kHz)
	Measurement time	Gating	Single, Repeat, Un-timed
		Gate time	Time: From 1 second to 99 days 23 hours 59 minutes 59 seconds
	Synchronization threshold		Internal, 10^{-n} (n = 2, 3, 4, 5, 6, 7, 8)
	Auto Sync		Automatic re-synchronization ON/OFF available
	Error performance	Calculation function	Provided (G.821)
		Item	EC, ES, EFS, SES, DM, US, %ES, %EFS, %SES, %DM, %US
	Alarm measurement	Measurement item	Clock loss, pattern sync loss

Table 1-6 Specifications (3/6)

Item			Specifications
Measurement	Relation to the Independent/ Combined modes		Independent: Independent measurement for each ED Combined: As follows: Error rate, number of errors: Independent ED measurement and Total measurement in the combination of correlating EDs. Others: Total measurement in the combination of correlating EDs. Independent measurement of each ED is not made.
	Current data		Cycle time: 500 ms
	Auto search function		The most optimum values of the input threshold and input phase are searched. Condition: At the time of PRGM: Mark rate shall be from 1/8 to 7/8, where there shall be at least one status change of 0/1 per 256 bits. At the time of Zero-Subst: Mark rate shall be from 1/8 to 7/8, where the 0-bit insertion length shall be set as follows: For Independent: Less than 256 For 2CH Combined: Less than 512 For 4CH Combined: Less than 1024
Input and output connectors	Data input	Input waveform	NRZ
		Input amplitude	0.5 to 2.0 Vp-p
		Threshold voltage	–3.000 to +1.750 V (1 mV step)
		Termination voltage	GND/–2.0 V
		Input impedance	50 Ω
		Connector	APC3.5

Table 1-6 Specifications (4/6)

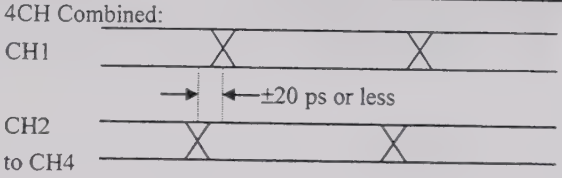
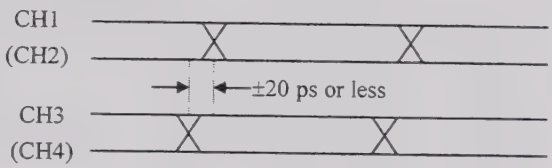
Item			Specifications
Input and output connectors	Data input	Phase between CHs (For Combined mode)	For 4CH Combined:  Crossed points for CH2 to CH4 shall be within the CH1 crossed point ±20 ps, and the bit relation of each 4CHs shall match. For 2CH Combined  Crossed point of CH3 (or CH4) shall be within the CH1 (or CH2) crossed point ±20 ps, and the bit relation of each 2CHs shall match. However, they are arbitrary in the case of Independent.
	Clock input	Input level	0.5 to 2.0 Vp-p
		Input waveform	Less than 0.5 GHz: Rectangle wave only (50% Duty) Others: Sine wave or rectangle wave (50% Duty)
		Clock delay	±500 ps (1 ps step)
		Polarity switch	CLOCK/$\overline{\text{CLOCK}}$
		Input impedance	50 Ω
		Connector	APC3.5

Table 1-6 Specifications (5/6)

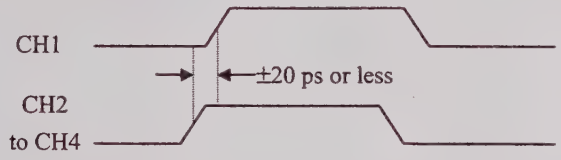
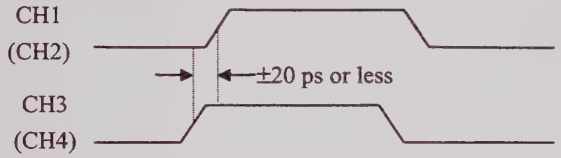
Item			Specifications
Input and output connectors	Clock input	Phase between CHs (In the case of Combined)	For 4CH Combined:  Rising edges of CH2 to CH4 shall be within the rising edge of CH1 ±20 ps. For 2CH Combined:  Rising edge of CH3 (or CH4) shall be within the rising edge of CH1 (or CH2) ±20 ps. However, this is arbitrary in the case of Independent.
	Synchronous output signal		2 kinds for 1 system are switched. Pattern Sync (FIX), 1/32 Clock
		Output level	V_{OH}: 0±0.25 V, V_{OL}: −1±0.25 V, Amplitude: 1 Vp-p±20%
		Connector	SMA
	Error output		DIRECT (1/8 ORED ERROR, LOW level at the time of error)
		Output level	V_{OH}: 0±0.25 V, V_{OL}: −1±0.25 V
		Connector	SMA
	Resync input		Sync loss at the LOW level
		Input level	V_{OH}: 0±0.1 V, V_{OL}: −1±0.1 V
		Connector	SMA
	Internal synchronization judging output		HIGH level is output when synchronization is established.
		Output level	V_{OH}: 0±0.25 V, V_{OL}: −1±0.25 V
		Connector	SMA
	Demux Reset output		Reset output for external Demux Unit LOW level at the time of Reset
		Output level	V_{OH}: 0±0.25 V, V_{OL}: −1±0.25 V
		Connector	SMA
	1/8 clock output	Output level	V_{OH}: 0±0.25 V, V_{OL}: −1±0.25 V
		Connector	SMA

Table 1-6 Specifications (6/6)

Item		Specifications
Screen display		Liquid crystal display with back light
	Size	10.4 inches, 640 × 480 dots
	Display color	Color (256 colors) (16 milion colors of VGA when using an external display)
	Connector	Mini D-sub 15-pin (for the connection with an external display)
Printer	Connector	Parallel port connector (for the external printer connection)
Keyboard		English 101-type keyboard
	Connector	PS/2 type, mini DIN6 pin
Mouse		Serial mouse
	Connector	PS/2 type, mini DIN6 pin
Touch panel		Touch panel
Floppy disk drive	Operation mode	2 modes (1.44 MB and 720 kB)
	Using disk	3.5-inch 2HD/2DD
Hard disk drive	Disk capacity	C drive: 474 MB (drive to save measured data, etc.) D drive: 30 MB (drive dedicated for virtual memory)
	Interface	IDE Interface
External control	RS-232C	COM1 D-sub9 pin
	GPIB *1	IEEE488.2 (SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0)
Sound		Alarm: ON/OFF available, Error: ON/OFF available
Panel lock		ON/OFF available
Operation ambient temperature range		15 to 35°C
Dimension and mass	Dimensions	426±5 (W), 266±5 (H), 584±5 (D) (mm)
	Mass	Maximum 50 kg
Power	Voltage	AC: 85 to 265 V
	Frequency	47.5 to 63 Hz
	Power consumption	Maximum 1 kVA

*1: Available when Option 01 (GPIB interface) is installed.

Section 2 Preparation Before Use

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2.1 Environmental Conditions for Installation

The MP1776A normally operates within the ambient temperature of 15 to 35°C and with ambient humidity of 85% or less. Keep the environment at a temperature between –20°C and 60°C, with 85% or less humidity when storing it.

Avoid use and storage under the following conditions:

1. Extreme vibration
2. Dust
3. Direct sunlight
4. Activated gas
5. Condensation

CAUTION ⚠

1. **Do not obstruct air inlets and outlets on the rear and sides. Specifically keep a distance of 10 cm or more between the rear and peripheral devices or other obstacles. Insufficient air flow increases the inside temperature resulting in a failure.**

2. **Condensation may cause a short circuit and failure when the MP1776A is again used at the room temperature after using at a low temperature for a long time. In this case, use after completely drying.**

2.2 Safety Measure

Avoid use under the following conditions for safety and prevention of damage to the MP1776A.

See 2.4 "Starting and Terminating MP1776A" for precautions on starting/terminating the MP1776A.

WARNING ⚠

1. **Connect the power cord after checking that the MP1776A main body power switch is turned OFF. Otherwise electric shock may result in injury or a death.**

2. **Always ground the cabinet ground terminal on the rear panel to prevent electric shock when using the 2-pole power outlet (without grounding).**

CAUTION ⚠

1. **Operable power is from AC 100 to 120 V, or from AC 200 to 240 V. Completely check the voltage and power rating to be used before connecting the power cord.**

2. **Avoid excessive voltage beyond the rating when inputting a signal to the MP1776A, or the circuit may be damaged.**

3. **Use output with 50 Ω termination, and never input a electric current to a output terminal.**

4. **Ground the other devices to be connected (including experiment circuits) as a static countermeasure by using grounding wires, before connecting input and output terminals.**

5. **Discharge the electric charges (on the outside conductor and core conductor) using any metal, etc. before use, because the outside conductor and the core conductor may form a capacitor to be charged.**

6. Connect the mouse, the keyboard, or the printer, when the power is turned off.

7. A hard disk is built into the MP1776A. Do not apply strong vibration or shock to the MP1776A to avoid damaging the hard disk.

8. Does not turn the power off while the hard disk access lamp on the front panel is turned ON. Otherwise the hard disk may be damaged.

9. Only use the attached dedicated pen and your finger for the touch panel.

10. Never open the MP1776A. Note that a maintenance request may be refused if the MP1776A is opened and the performance deteriorated.

11. The life of the battery used for memory backup for the MP1776A is about 7 years. When the life period expires, the information in backup memory will be lost, and the status at the time of the last power off may not be reproduced when the power is turned ON at the next time. Change the battery early.

12. Do not remove the radiation plate inside the unit. Note that a maintenance request may be refused if removal resulted in performance deterioration or a malfunction.

2.3 Grounding

Connect the 3-pole power cord attached to the MP1776A to the grounded power outlet so that the MP1776A is grounded when supplying power to the MP1776A.

When there is no grounded power outlet (3-pole type), use the attached conversion adapter to convert the power cord to 2-pole type. Then, ground the grounding terminal on the rear panel before connecting the power code to the outlet.

WARNING ⚠

Electric shock may occur leading to injury or death if power is supplied without grounding the MP1776A. Connect the 3-pole power cord to the grounded 3-pole power outlet, or ground the grounding wire of the conversion adapter or the grounding terminal on the rear panel.

2.4. Starting and Terminating MP1776A

Microsoft® MS-DOS® operating system (abbreviated as MS-DOS® hereafter) and Microsoft® Windows® operating system (abbreviated as Windows® hereafter) are used as the software for the screen operation of the MP1776A. Therefore the application for the MP1776A can be operated in the same way as an application on Windows®. Start/Terminate methods, including precautions at starting and terminating for the MP1776A are explained here.

Starting MP1776A

To start the MP1776A, follow the below:

- Turn ON the power.
  Turn ON the power of the MP1776A. The system is started and then the application is automatically started.
- Start from Program Manager for Windows®.
  Double-click the MP1776A icon in the MP1776A group in Program Manager. The application is started.

Note:

The setting status immediately before power off is saved in the internal memory of the MP1776A. Therefore, the setting condition at the last power off is recovered when the power is turned on again.

However, the remote status and the panel lock status are set to the initial status, below.
(Remote status: Local, Panel lock status: OFF)

Terminating of MP1776A

Follow these procedures to terminate the MP1776A:

1. Select [File] - [Exit] on the menu bar at the Main window. The MP1776A application is terminated so that only Windows® operates.
2. Select [File] - [Exit Windows] from Program Manager of Windows®. Windows® is terminated.
3. The menu program for MP1776A starts when Windows® is terminated. Turn off the power when the menu program is started.

CAUTION ⚠

1. **The hard disk drive may fail if the MP1776A is terminated without following the above instructions (by turning OFF the power switch on the front panel during operation, etc.). Terminate the MP1776A following the above instructions except for incidental accidents (power failure, accidental unplugging power cord, etc.) in order to protect the hard disk drive.**

2. **Do not turn OFF the power while the HDD is accessed (the access lamp is turned ON). Otherwise the hard disk drive may fail.**

2.5 Calibrating Touch Panel

The MP1776A screen operation can be performed by using a touch panel. Before using the touch panel, an adjustment is necessary to provide the software with the correct position where you touch the panel. The adjustment of the touch panel before use is explained here.

1. Double-click the TTSetup3.20 icon in the Main group of Program Manager. Application for touch panel setup is started.
2. Execute [Calibrate] from the menu bar of the application for touch panel setup. Perform the touch panel calibration in accordance with indications displayed on the screen.
3. Calibration is completed as above. Select [Exit] from the menu bar. The application for touch panel setup is completed.

Note:

Do not perform a function except for [Calibrate] of the application for touch panel setup. A function execution or setting change may make it difficult to operate the touch panel normally.

2.6 Stable Use of the Application

Software, such as drivers to control devices, is installed in the MP1776A in addition to MS-DOS® and Windows®.

No stable application operation can be assured if a change except for those described in this operation manual is made, although the use environment of Windows® can be changed by using Control Panel and the Windows Setup program.

Do not change the Windows® use-environment for a purpose or a method other than those described in this operation manual.

2.7 Recovering Software

The MP1776A is controlled by various softwares such as MS-DOS®, Windows®, control applications, etc. The MP1776A may not start normally when a part of the above mentioned software is damaged by a HDD failure due to some cause, an erroneous filé operation, etc. during use of the MP1776A.

When this kind of thing occurs, software recovery is necessary by using the recovery tool attached to the MP1776A.

Notes:

1. A keyboard is necessary to recover the software for the MP1776A. First, connect the external keyboard to the MP1776A.

2. When the software is recovered, all the information inside the hard disk is lost. It is recommended to always back up various kinds of data, such as measured result data and setup data saved in the hard disk.

3. Do not use the recovery tool on any other device (personal computers, etc) except for the MP1776A, because it is a violation of the contract for the software use.

Recovery tool configuration

The recovery tool recovers MS-DOS®, Windows®, control application, etc. The recovery tool includes the following 2 recoveries:

1. Operating systems recovery
   MS-DOS®, Windows®, and various drivers are recovered so that Windows® operates normally. In addition, LEDs, rotary encoder, panel keys, touch panel, and software keyboard can be used again.
2. Application recovery
   The control application for MP1776A is recovered, and the MP1776A can be normally used as a measuring instrument again.

Preparation before recovery

Before beginning the recovery, the following preparations are necessary:

1. Connect an external keyboard, as follows.
   Recovery is impossible without a keyboard. Connect a keyboard to the keyboard connector on the rear panel of the MP1776A.
2. Change the status to enable start from the floppy disk at power ON, as follows.
   The MP1776A is usually set so that the software is started from the hard disk drive when the power is turned ON. The recovery floppy disk must be inserted into the MP1776A to start the recovery tool on the disk to recover. Change the setting, therefore, to start setup of the MP1776A from the floppy disk at the time of power ON. Change it at power OFF by using the following procedures:
   [1] When "Ctrl+Alt+S to run the setup utility" is displayed on the screen after turning ON the power; press the S key (alphabet "S") while pressing the Ctrl and Alt keys. The setup screen (shown below) is displayed.
   [2] Move the cursor to the Quick Boot position on the screen. Current status is Enabled (the status to be started from the hard disk drive). Change it to Disabled (the status to be started from the floppy disk drive) by using the +/– key.

   Note:

   Do not change the settings except for Quick Boot. The setting for the setup screen is returned to the initial status when the power is turned OFF.

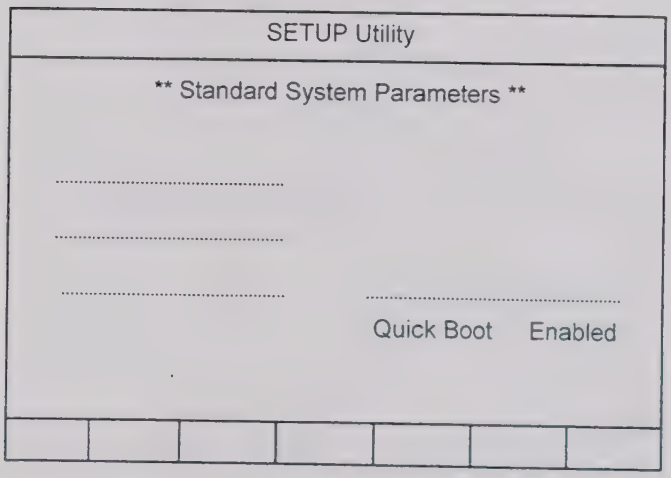

Fig. 2-1 Preparation before recovery

   [3] Insert DISK1 of recovery disks into FDD.
   [4] Press the ESC key and then press the F4 key. The recovery tool is started from the floppy disk and the recovery is started.

Recovery procedures

Recovery procedures are explained as follows:

- Recoverying Operating System
  1. When the preparation before recovery is finished, the recovery tool is started and the message shown below is displayed.
     When [Y] is input, the recovery is continued to start the partition setup.
     When [N] is input, the recovery is discontinued.
     Input [Y] here.

```
MP1776A
--------Recovery Tool--------
Initializing Hard Disk Drive
WARNING!! All Data on Hard Disk Will Be Deleted!
Are You OK? [Y/N]
```

Fig. 2-2 User confirmation screen

  2. The message shown below is displayed during the partition setup. The system is started when the partition setup is completed.

```
MP1776A
--------Recovery Tool--------
Now, setting partition on the hard disk, and when it
finish, system will reboot and format the hard disk
automatically.
Keep the floppy disk inserted.
Creating Drive C (479 MB)...
Creating Drive D ( 30 MB)...
```

Fig. 2-3 Setting up partition, in progress

  3. When the system is started, the C and D drives are formatted. Before starting format, despite of the displayed message that asks whether to format or not, [Y] is automatically input to the MP1776A and formatting is started.

4. When format is finished, files are copied to the HD. Change the FD in accordance with the indication on the screen.

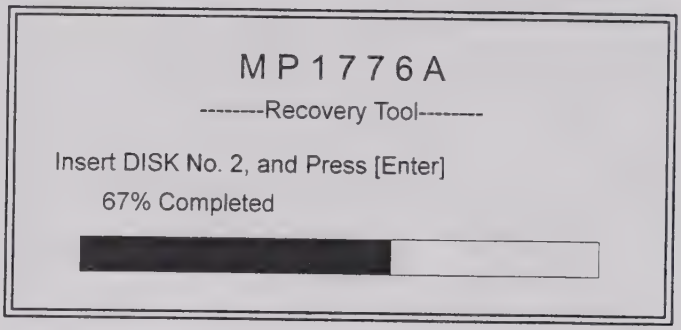

Fig. 2-4 Copying

5. The message shown below is displayed when recovery of Operating systems is finished. Remove the FD and press the [Enter] key. The system is re-started and Windows® starts.

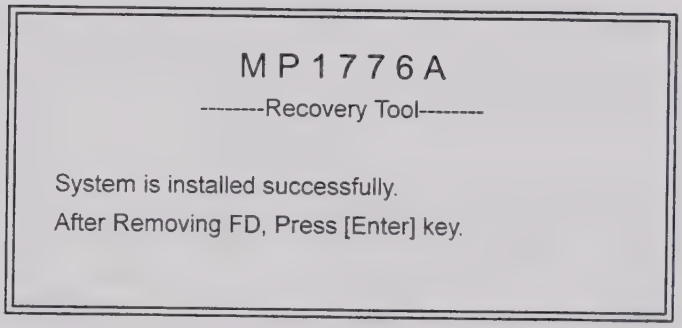

Fig. 2-5 OS recovery completion

- Recovering application

  Perform the recovery of application in accordance with the following procedures:

  1. Insert DISK1 of application recovery disks into FDD, and select [File] - [Run] of Program Manager. Input "a:\setup" to the Command Line text box, and press the OK button. Application recovery is started. Change the FD in accordance with the indication on the screen.
  2. When the recovery is completed, the MP1776A group and the application icon (icon name: [MP1776A]) are generated in Program Manager, and Windows® is re-started.
  3. Now, operating system and application recoveries are completed as above.

Message during recovery

The message shown below may be displayed during application recovery. Handling method for the message is explained here.

- "MP1776A application is running."
  This message is displayed if the application is running. Execute the recovery after terminating the application when you want to continue the recovery.

Section 3 Panel Explanation and Setup

3.1 Panel Explanation 3-2
3.2 Setup 3-6
3.2.1 Setup example for peripheral devices..... 3-6
3.2.2 Connecting peripheral devices..... 3-7

3.1 Panel Explanation

Figures for the front panel views and rear panel views, and explanation of each part of the main frame of the MP1776A and the MU177601B 12.5 Gb/s Error Detector unit are as follows:

- **Main frame**

Front panel

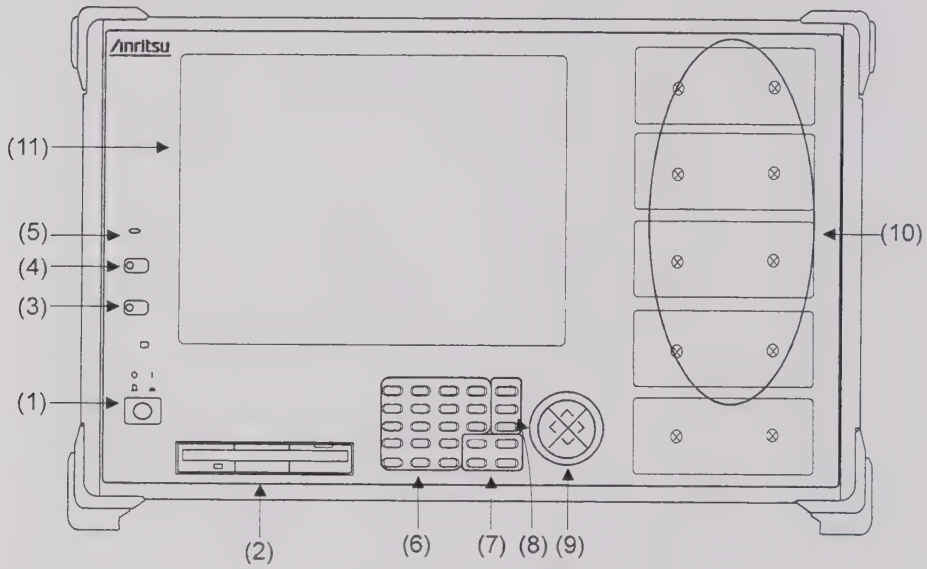

Fig. 3-1 Front panel

Number	Label	Name	Description
1		Power switch (with power ON LED)	This is the switch to turn ON/OFF the AC power.
2		Floppy disk drive	This is the 3.5-inch FDD. FD of 2DD (720 kB) or 2HD (1.4 MB) can be used.
3	Panel Lock	Panel operation lock key	This is the key to disable the operation on the front panel. The panel is locked at the time when the LED goes ON.
4	Remote	Local key (with remote LED)	This is the key to change the remote status to the local operation. LED goes ON at the remote status.
5	HDD	Hard disk drive access LED	The LED goes ON while accessing the hard disk drive.
6	[0] to [9], [–], [.], [A] to [F]	Numerical value control key	This is the key to input numerical values.
7	Tab, Shift, BS, Enter	Screen control key	This is the key for screen controls, such as the input confirmation, the focus movement, etc.
8	m/k, n/M, p/G	Unit key	Units are determined at numerical value input.
9		Rotary encoder (with up, down, left, and right keys)	Numerical values are continuously changed. The up, down, left, and right keys are used for inverted cursor movement, etc.
10		Slot 1 to Slot 5	The front panel of the unit inserted at Slots 1 to 5 appears at this position.
11		Color LCD	This is the display equipped with the touch sensor to display the setting items and measured results.

Rear panel

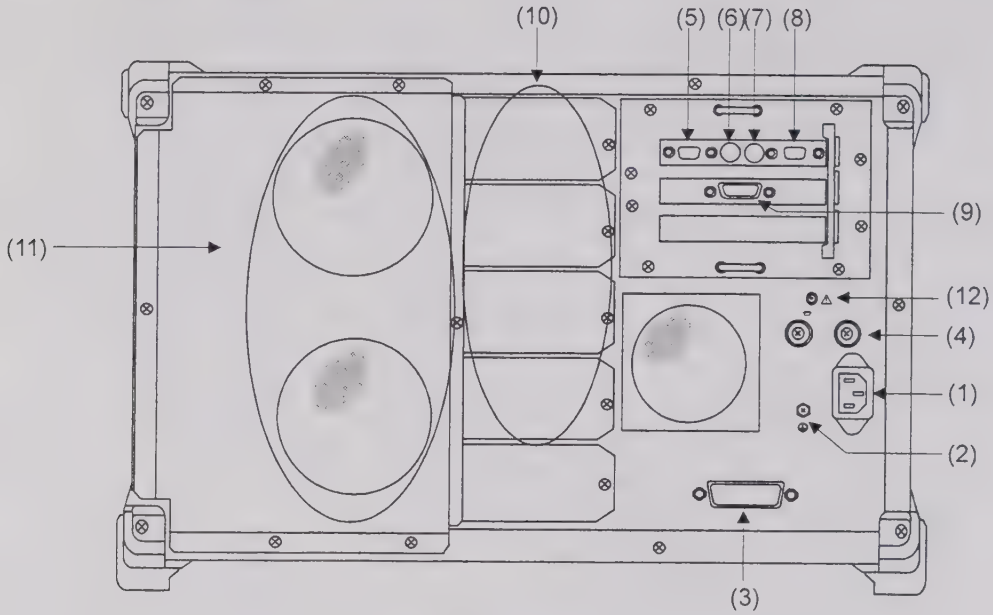

Fig. 3-2 Rear panel

Number	Label	Name	Description
1		AC power input connector	This is the connector for AC power supply.
2		Frame ground	This is the frame ground terminal.
3	Printer	Printer connector	This is the connector for the external printer.
4		Fuse holder	This is the fuse holder for AC power supply.
5	RS-232C (COM1)	RS-232C connector	This is the connector for connecting the MP1776A to an external controller using the RS-232C interface.
6	Keyboard	Keyboard connector	This is the connector for the keyboard.
7	Mouse	Mouse connector	This is the connector for the mouse.
8	CRT	VGA connector	This is the connector for the external display.
9	GPIB (OPT01)	GPIB connector	This is the connector for connecting the MP1776A to an external controller using the GPIB interface.
10		Slot 1 to Slot 5	This is the slots for inserting connector-in units.
11		Fan	These are the fans for cooling.
12	Resync Input	Resync input connector	This is the connector to input the synchronization signal of Data Enable/Disable when receiving burst signal.

- **MU177601B 12.5 Gb/s Error Detector**

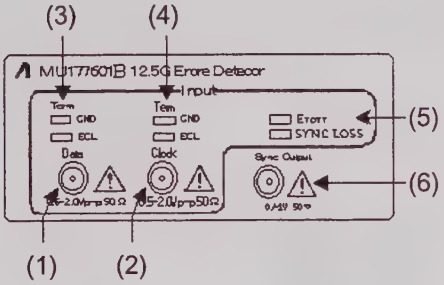

Fig. 3-3 Front view of MU177601B 12.5 Gb/s Error Detector

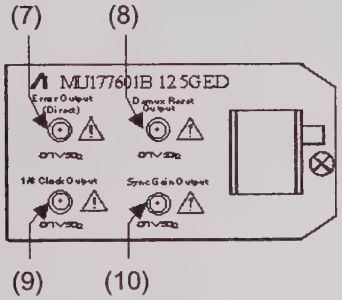

Fig. 3-4 Rear view of MU177601B 12.5 Gb/s Error Detector

Number	Label	Description
1	Data	Connector for data input (APC3.5)
2	Clock	Connector for clock input (APC3.5)
3	Data Term	LED for data input termination voltage display LED (corresponding to the termination voltage selected on the screen) is turned ON.
4	Clock Term	LED for clock input termination voltage display. LED (corresponding to the termination voltage selected on the screen) is turned ON.
5	Error/Sync Loss Monitor	Error/Sync Loss Monitor LED
6	Sync Output	Connector (SMA) for synchronization output
7	Error Output (Direct)	Connector (SMA) for error output
8	Demux Reset Output	Reset output connector (SMA) for external Demux Unit
9	1/8 Clock Output	Connector (SMA) for 1/8 clock output
10	Sync Gain Output	Connector (SMA) for internal synchronization judging output

3.2 Setup

3.2.1 Setup example for peripheral devices

Mouse, keyboard, printer, external display, and personal computer (used as a controller) can be connected to each connector on the rear panel of the MP1776A.

The setup example are shown in the following figure:

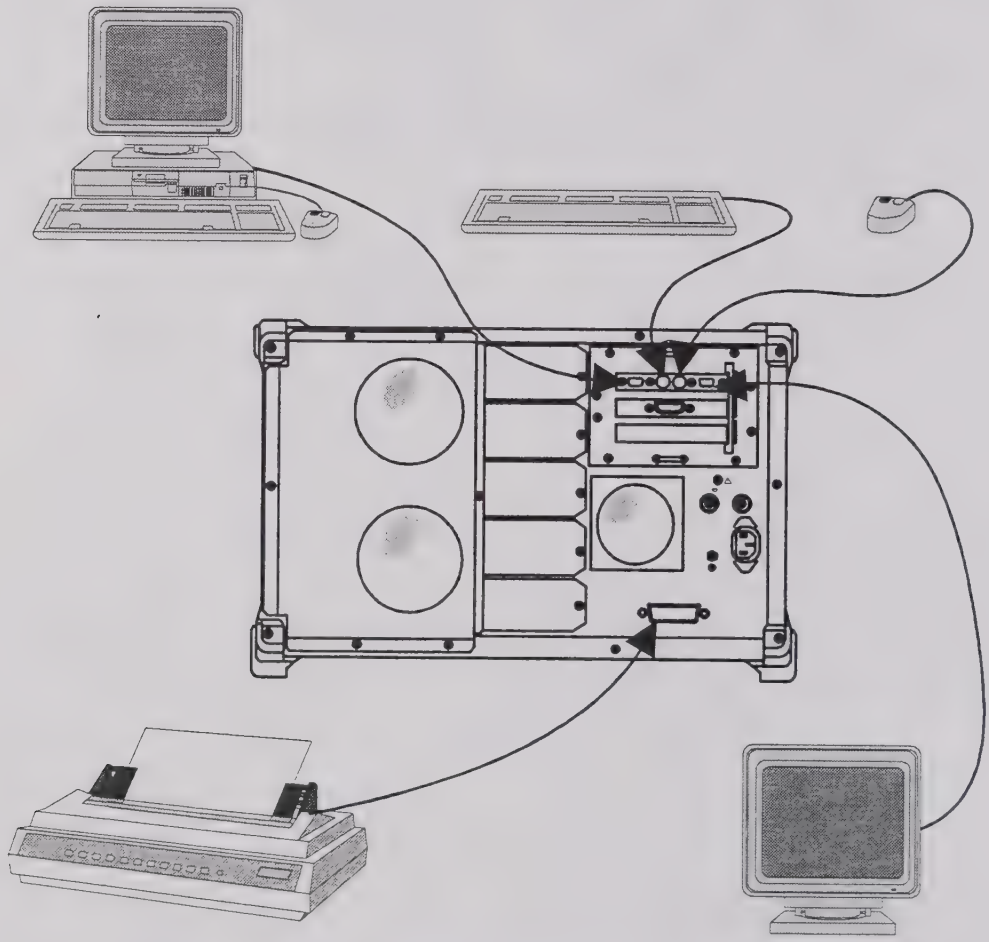

Fig. 3-5 Setup of peripheral devices and external devices

3.2.2 Connecting peripheral devices

Setup and precautions for connecting peripheral devices are explained here.

■ Mouse

Turn ON the power after connecting the serial mouse (standard attachment for the MP1776A) to the mouse connector on the rear panel at power OFF. The mouse becomes operable when the application is started.

Select Mouse from Control Panel of Microsoft® Windows® operating system to set the details setup (moving speed, double click interval, etc.) for the mouse.

Note:

Control Panel is opened by double-clicking the Control Panel icon in the Main group of Windows®.

■ Keyboard

Turn ON the power after connecting the 101-type keyboard (optional) to the keyboard connector on the rear panel at power OFF. The keyboard becomes operable when the application is started.

Select Keyboard from the Windows® Control Panel, and set the detailed setup (auto-repeat function setting etc.) of the keyboard.

Note:

Select the Windows Setup program in the Main group of Program Manager to setup the keyboard when connecting a keyboard other than 101-type keyboard.

■ Printer

Turn ON the power after connecting the printer to be used to the printer connector on the rear panel at power OFF. Select Printers from the Windows® Control Panel to set up the printer when the application is started.

Note:

When setting the printer using Printers in Control Panel, a message "Insert Microsoft Windows 3.1 Disk#5...." may appear. At that time, insert the attached recovery disk into the floppy disk drive of the MP1776A. The relation between the disk number displayed in the message and the recovery disk number to be inserted are shown in the following table:

Disk numbers displayed in message	1	2		5	6
Corresponding recovery disk numbers	5	6		9	10

■ External display

Connecting an external display enables the high resolution display.

Procedures are explained below to connect an external display for high resolution display:

1. Connect a display to be used to the VGA connector on the rear panel at power OFF.
2. Turn ON the power. The application is displayed on both the CRT for the connected external display and the LCD on the front panel of the MP1776A.
3. Select the ChipsCLP icon from Control Panel for Windows® to start the Display Driver Control Panel program.
4. Set the screen status to be used by selecting resolution, number of colors, and font size; and select CRT in the Display group box.
5. The setup is completed. Press the OK button. The Display Driver Control Panel program is finished.

Note:

The display of other screens disappears when you select CRT or LCD in the Display group box setting of the Display Control Panel program, as below.

The LCD display on the front panel of the MP1776A disappears when you select CRT. The CRT display of external display disappears when you select LCD.

Section 4 Window Explanation

4.1 Window Types 4-2
4.2 Windows Configuration 4-4
4.2.1 The hierarchical structure of windows 4-4
4.2.2 Window display list 4-5
4.2.3 Tool bar configuration 4-7
4.3 Opening/Closing Windows 4-8
4.3.1 Opening/closing sub-windows and switching displays 4-8
4.3.2 Switching panels 4-11
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4.1 Window Types

The MP1776A has multiple setup windows and display windows. Windows can be roughly grouped into 4 types by their operations and functions. Windows are referred to by the following names in this operation manual:

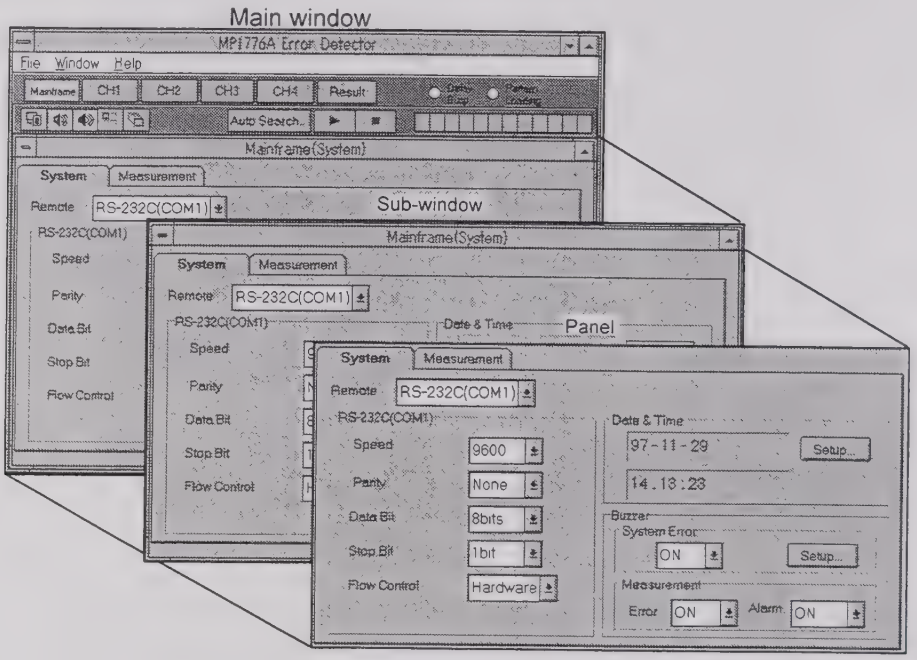


Fig. 4-1 Window types

- Main window
  Indicates the window first displayed when the application is started. This window allows you to open sub-windows and to finish applications.

- Sub-window
  Indicates windows opened by pressing sub-window open/close buttons on the Main window. There are panels for setup/display in the sub-window.

- Panel
  Indicates windows opened by switching tabs on the sub-window. Various setting contents and measured results are displayed on the panel.

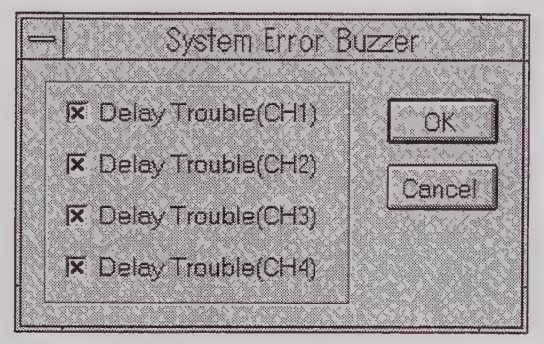


Fig. 4-2 Dialog box

- Dialog box
  Indicates windows opened by executing command buttons and menu items on the panel. Once a dialog box displayed by the MP1776A is opened, proceeding to the next operation is not allowed unless it is closed.

4.2 Windows Configuration

4.2.1 The hierarchical structure of windows

The hierarchical structure of Main window, sub-windows, and panels are as follows when four units of Error Detectors are inserted into the MP1776A:

Table 4-1 Hierarchical structure of windows

Sub-window	Panel	Setting item
Mainframe	System	Date and time, remote function, and Buzzer ON/OFF are set.
	Measurement	Independent/Combined Modes and measurement conditions are set.
CH1	—	Input interface, pattern, error detection mode of CH1* are set.
CH2	—	Input interface, pattern, error detection mode of CH2* are set.
CH3	—	Input interface, pattern, error detection mode of CH3* are set.
CH4	—	Input interface, pattern, error detection mode of CH4* are set.
Result	—	Error/alarm measured results are displayed. Window display is switched, depending on Independent/Combined Modes.

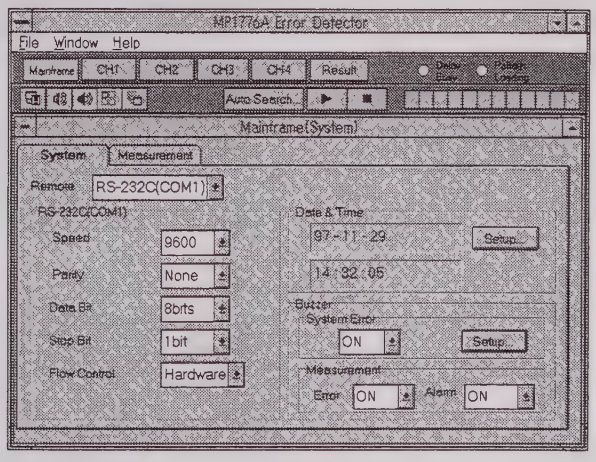
*: Error Detectors inserted into slots are called as follows, on the MP1776A window and in the operation manual description:

Error Detector inserted into the slot 1: CH1
Error Detector inserted into the slot 2: CH2
Error Detector inserted into the slot 3: CH3
Error Detector inserted into the slot 4: CH4

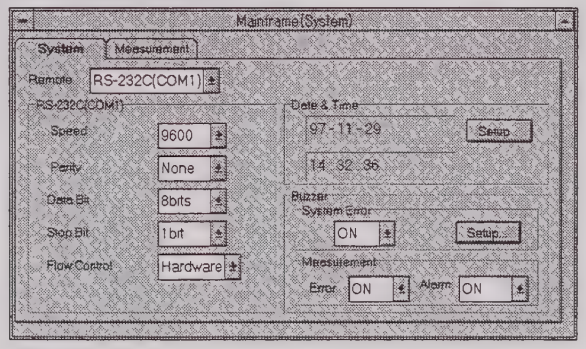
4.2.2 Window display list

The setup and display windows of the MP1776A are as follow:

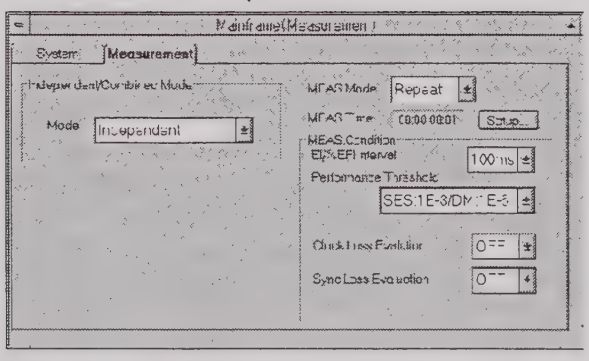
- **Main window**



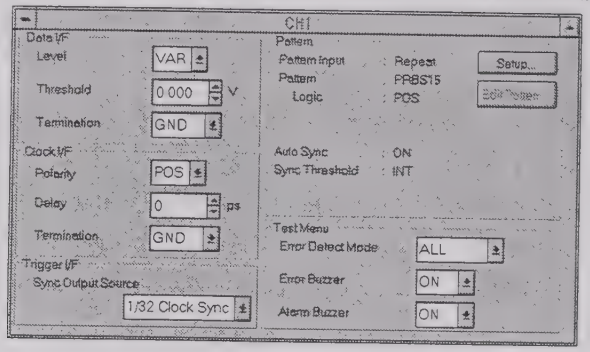
- **The Mainframe: System panel**



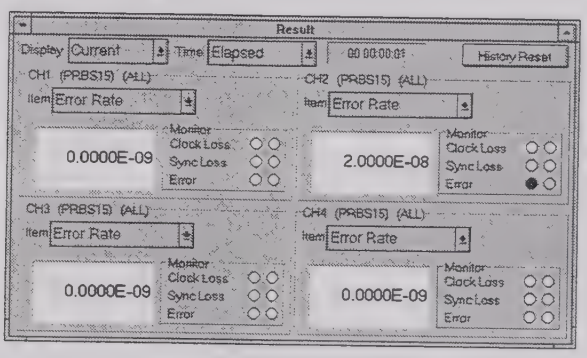
- **The Mainframe: Measurement panel**



- The CH1 sub-window (the same also for the CH2 to CH4 sub-windows)



- The Result sub-window

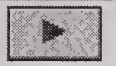
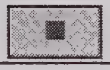


4.2.3 Tool bar configuration

Several kinds of icons are provided on the tool bar of the MP1776A. Icons are buttons corresponding to functions to be frequently used and pressed to execute the corresponding functions.

Functions corresponding to icons are explained below. All the following icons are enabled when an Error Detector is inserted into the MP1776A:

Button	Function	Corresponding command
	Executes the hard copy.	[File] - [Hard Copy] on the menu bar
	Sets ON/OFF of error Buzzer.	Error buzzer ON/OFF setting on the Mainframe: System panel
	Sets ON/OFF of alarm Buzzer.	Alarm buzzer ON/OFF setting on the Mainframe: System panel
	Relocates (Tile format) windows.	[Window] - [Tile] on the menu bar
	Relocates (Cascade format) windows.	[Window] - [Cascade] on the menu bar

Command button	Function
	Executes Auto Search.
	Starts measurement.
	Terminates measurement.

4.3 Opening/Closing Windows

4.3.1 Opening/closing sub-windows and switching displays

Opening/closing sub-windows and switching displays are explained here.

Opening/closing sub-windows

- Opening sub-window:
  Press the open/close button for the sub-window on the Main window. The sub-window corresponding to the button label is opened.

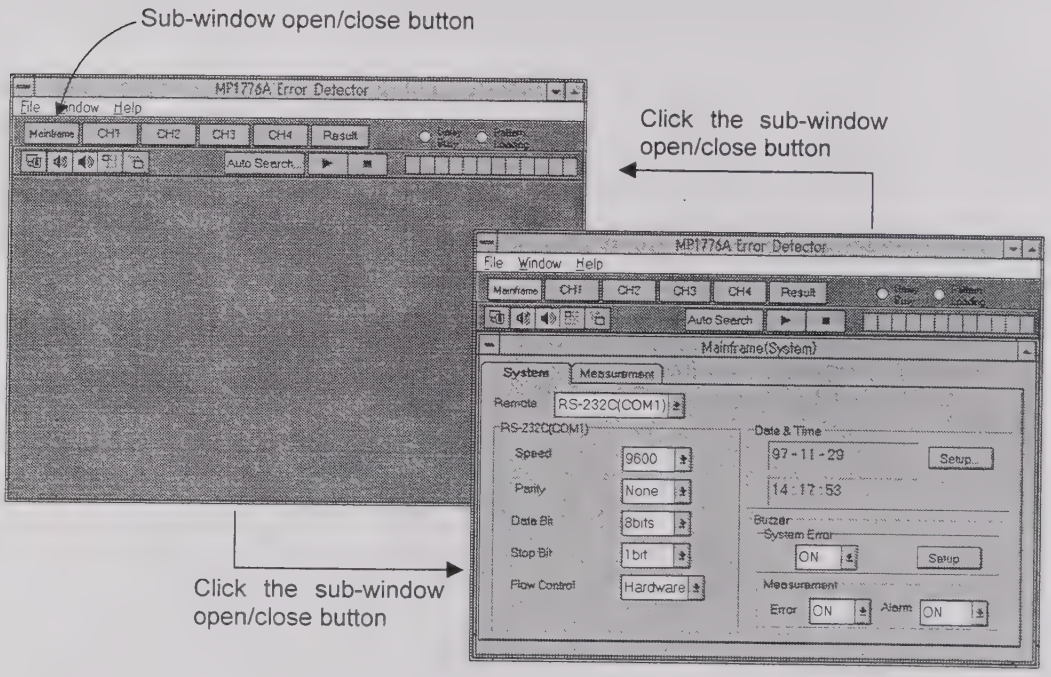


Fig. 4-3 Opening and closing sub-windows

- Closing sub-window:
  Again press the button that you previously pressed to open the window. The sub-window corresponding to the button label is closed.

- Opening multiple sub-windows at the same time:
  Multiple sub-windows can be opened at the same time. Press the multiple buttons for the sub-windows to open.

Switching sub-window displays

Open sub-window can be enlarged, as below. Also, the displays can be switched.

- Maximizing sub-window:
  Press the maximize button. The sub-window is displayed in the maximum size on the Main window.

- Returning the maximized sub-window to the original size:
  The maximize button is changed to the restore button when the window is maximized. Press the restore button to return the maximized sub-window to the original size.

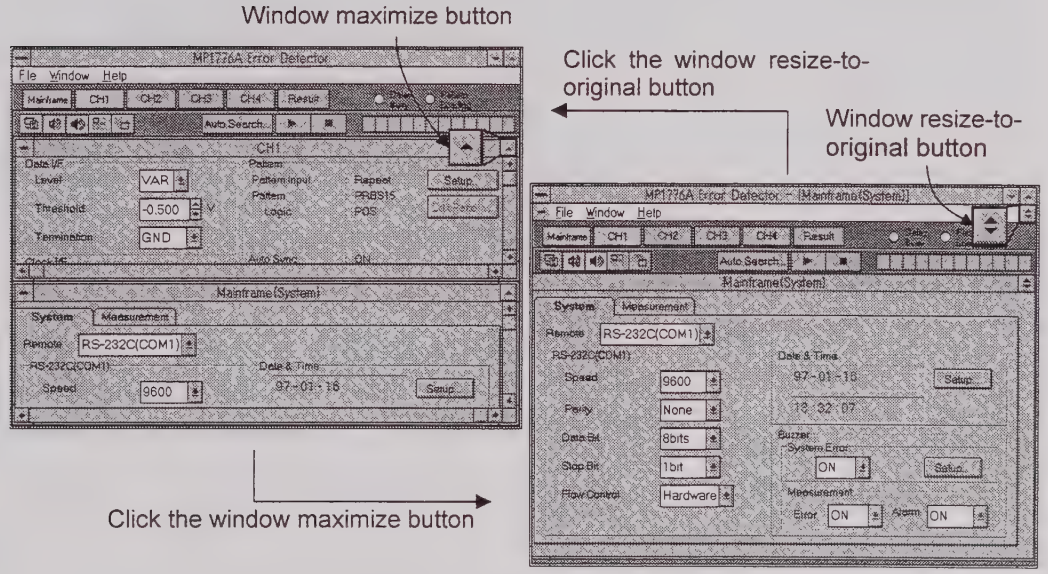

Window maximize button
Click the window resize-to-original button
Window resize-to-original button
Click the window maximize button

Fig. 4-4 Sub-window displayed in the maximum size

- Displaying sub-windows in Tile format:
  Select [Window] - [Tile] from the Main window menu bar. Multiple sub-windows opened are displayed on the Main window in Tile format.

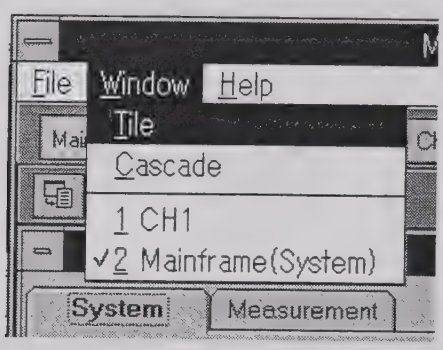


Fig. 4-5 Window menu

- Displaying sub-windows in Cascade format:
  Select [Window] - [Cascade] from the Main window menu bar. Multiple sub-windows opened are displayed on the Main window in Cascade format.

- Moving focus on sub-window:
  Click the inside of the window frame of the sub-window to move the focus on it. Or select [Window] - [Sub-window name] from the Main window menu bar. The focus is set on the selected sub-window, and the title bar is highlighted.

4.3.2 Switching panels

Multiple panels are present in a sub-window. Contents of multiple panels in a single sub-window cannot be displayed at the same time.

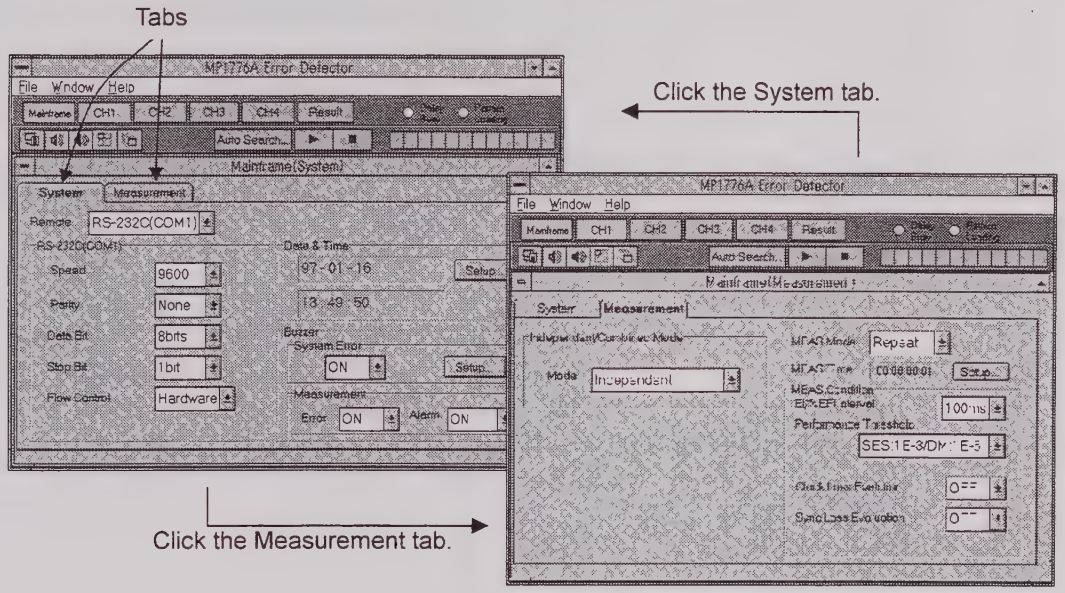


Fig. 4-6 Switching panels

- Displaying the hidden panel:
  Click the tab of the panel to display what is hidden behind the currently displayed panel. The selected panel is displayed.

4.4 Basic Setup Methods

These are the following two setup methods for the MP1776A, as below:

- Direct setup by using controls on the panel of sub-window
- Setup by opening the dialog box

Direct setup by panel controls or on sub-window

When controls that exist on sub-windows and panels are changed, the changed content is set immediately after the change. The operation corresponding to the setting is performed.

However, the confirmation dialog box is opened for some items to ask whether the set change is correct. This is to prevent the hardware damage by an erroneous operation when the input-interface termination condition setting or the level setting is changed. The setting is done by pressing the OK button on the dialog box, or it is returned to the previous setting by pressing the Cancel button.

Setup by opening dialog box

For a dialog box; only the set contents are displayed on the sub-window, and the Setup... button is present in a group box that cannot be set up directly. In this case, press the Setup... button to open the dialog box, and change the setting, as described below.

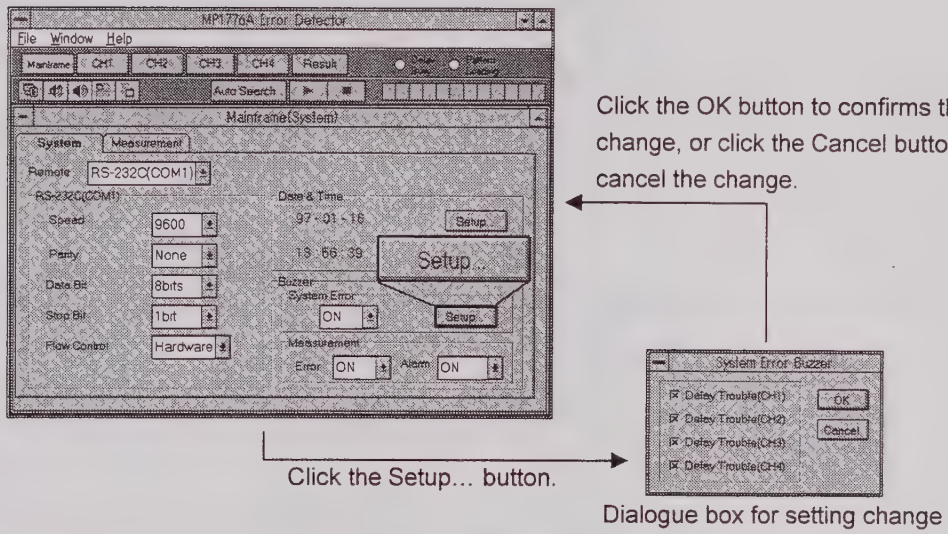


Fig. 4-7 Basic setup method

1. Press the Setup button corresponding to the item to change the setting. The Setup dialog box is opened.
2. Change the setting in the dialog box. The changed setting contents in dialog box are only displayed, and do not affect the operation of the MP1776A itself at this stage.
3. Press the OK button to close the dialog box. At this time, changed contents are set for the first time, and the operation corresponding to changed contents is started. Close the dialog box by pressing the Cancel button when you want to cancel the contents changed in the dialog box, and return them to the previous condition.

4.5 Inputting Data

Windows of the MP1776A are operated as follows:

- Operations with mouse
  The application of the MP1776A can be operated with the mouse in the same way as the application operated on the Windows® in a personal computer.

- Operations with the touch panel
  Operations (equal to those performed with the mouse) can be performed with the touch panel of the MP1776A. Touch the touch panel with your finger or the dedicated pen.

- Operations with keys and rotary encoder on front panel of MP1776A
  The application can be operated with keys and the rotary encoder on the front panel of the MP1776A, in the same manner as the operation on the Windows® using a personal computer keyboard. In this case, the some operations of those using the keyboard cannot be performed due to the limited number of keys on the MP1776A.

- Operations with keyboard
  The application of the MP1776A can be operated by using an external keyboard connected to the MP1776A.

- Operations with software keyboard
  Software keyboard is provided in the MP1776A as an application program to operate on Windows®. Even if there is no hardware keyboard, alphanumeric characters can be input by using the software keyboard. See 4.6 "Using Software Keyboard" for the use method of the software keyboard.

Data input method using the front panel keys and the rotary encoder is explained here, including the difference in the operation methods.

Moving focus among controls in window

When multiple controls are placed in a window, the focus can be moved among controls, as follows:

- [Tab] key
  The focus is moved from the control placed at the upper left of the window to the right direction.
- [Shift] + [Tab] keys
  The focus is moved to the opposite direction using the [Tab] key.

Window operations

Window size change and movement, etc. using the panel keys are explained below.

1. Click the control box of the desired window to open the control menu.
2. Select a window operation function to be performed in the control box by using the [↑], [↓], and [Enter] keys.
3. Operate the window by using the [↑], [↓], [→], and [←] keys in accordance with the selected function.
4. Press [Enter] key for confirmation.

Inputting data using spin box

Inputting numerical value to the spin box using keys and the rotary encoder are explained, below.

1. Set the focus on the spin box to be input. When the focus is set on the numerical value, one of its digits is inverted.
2. Move the inverted cursor to select the digit to change the numerical value.
   There are the following methods to move the cursor:
   - Move it using the [←] and [→] keys (rotary encoder [↑]).
   - Click the required digit.
3. Change the numerical value, as below. Numerical values can be continuously changed by the following procedures based on the digit where the inverted cursor is placed.
   - Click the spin button.
   - Rotate the rotary encoder.
   - Press the [↑] and [↓] keys (rotary encoder [↑]).
4. In addition, numerical values can be directly input by using numerical value keys. In this case, the current setting display is cleared, regardless of the position of the inverted cursor. The display is cleared when the [BS] key is pressed before confirming the input value.
5. Press the unit key or the [Enter] key to confirm the input data when directly changing a numerical value by using numerical value keys.
   The set values are canceled if one of the following operations is performed before pressing the unit key or the [Enter] key to confirm the data:
   - Moving the focus to other control.
   - Closing the dialog box.
   - Moving to other application.

4.6 Using Software Keyboard

4.6.1 Inputting characters

Only minimum keys necessary to input numerical values are provided on the front panel of the MP1776A. Therefore, the software keyboard is prepared as a supplementary function to input characters. Characters can be input by using the software keyboard even if no keyboard is connected to the main body.

Use of the software keyboard is explained by an example to input a file name in the Save dialog box.

1. Execute [File] - [Save] in the Main window to open the Save dialog box.
2. Double-click the virkey icon in the [MP1776A] group of Program Manager. The software keyboard is started.
3. Click the text box (the File Name text box in this case) that you want to input characters, and click a key on the software keyboard. The clicked character is input to the text box.

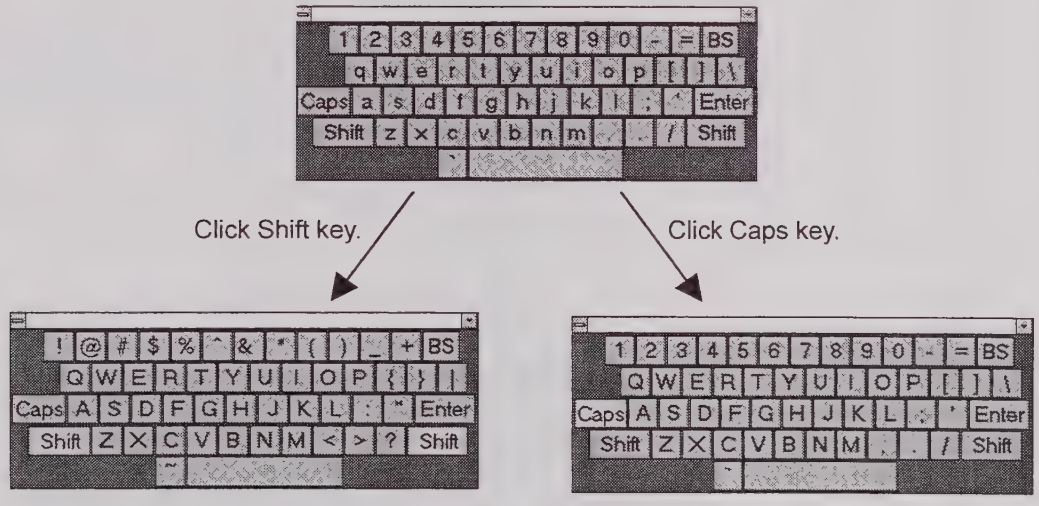


Fig. 4-8 Software keyboard

4. Open the control box at the upper left of the software keyboard and select [Exit] to finish the software keyboard.

Note:

The character is input to the control (controls such as text box, spin box, etc. to which a text can be input) on which the current focus is set when a key is pressed on the software keyboard. Input is enabled not only for the File Name text box explained in the example above, but also the spin box and the Notepad of Windows® that numerical value can be input.

4.6.2 Setting software keyboard

The size and the display format of the software keyboard attached to the MP1776A can be changed in accordance with the use condition.

- Changing size

  Click the button at the upper left of software keyboard to open the control box.
  Click SIZE of the menu, and select a size from among SS, S, M, L, and LL.
  A check mark is placed on the selected size.

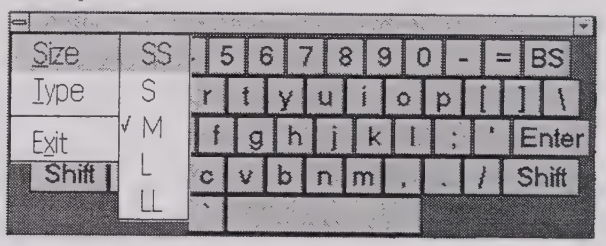


Fig. 4-9 Changing size

- Changing display format

  Click the button on the upper left of software keyboard to open the control box.
  Click TYPE of the menu, and select a type from among Full-Key, 10-Key, and 16-Key. A check mark is placed on the selected type.

Full-Key	All keys can be used.
10-Key	Numerical value keys can be used.
16-Key	Numerical value keys and character keys (A to F) can be used.

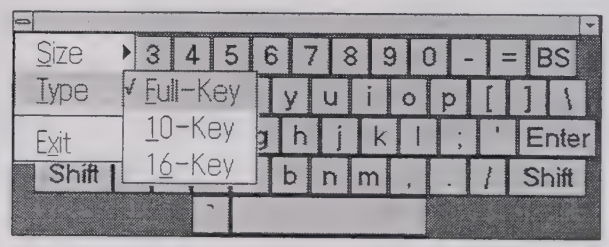


Fig. 4-10 Changing display format

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5.1 Setting Independent/Combined Modes

5.1.1 Description of Independent/Combined Modes

The independent measurement mode for each CH and the measurement modes with correlation between CHs are present in the MP1776A. Maximum signal frequency of 12.5 GHz × 4 = 50 GHz can be measured by combining with the external DEMUX equipment in the correlation mode.

- Independent Mode

Each CH is independently measured. There is no correlation among CHs in the setting status inside ED of this case.

A maximum of 4 equipment can be measured in this mode at a frequency range from 100 MHz to 12.5 GHz.

- 2CH Combined Mode

Measurement is performed to provide the correlation among CHs in the combinations of the pair of CH1 and CH3 and the pair of CH2 and CH4. The reference pattern generated inside ED of this case is the 1:2 DEMUXed pattern based on the original pattern.

Therefore, the maximum frequency of 12.5 GHz × 2 = 25 GHz can be measured by being combined with the 1:2 DEMUXed equipment.

In addition, in this case, the pattern setting, the synchronization setting and the error detection mode setting are identical for each the pair of CH1 and CH3 and the pair of CH2 and CH4.

- 4CH Combined Mode

Measurement is performed to provide correlation among CHs in a combination of CH1 thru CH4 as a group. The reference pattern generated inside ED of this case is the 1:4 DEMUXed pattern based on the original pattern.

Therefore the maximum frequency equivalent to 12.5 GHz × 4 = 50 GHz can be measured by being combined with the 1:4 DEMUX equipment.

In addition, the pattern setting, the synchronization setting, the error detection mode setting are identical for all the CHs in this case.

5.1.2 Procedures for setting Independent/Combined Modes

Changing mode between Independent/Combined Modes on the screen and precautions for the change are explained here.

Procedure:

1. Open the Mainframe: Measurement panel.

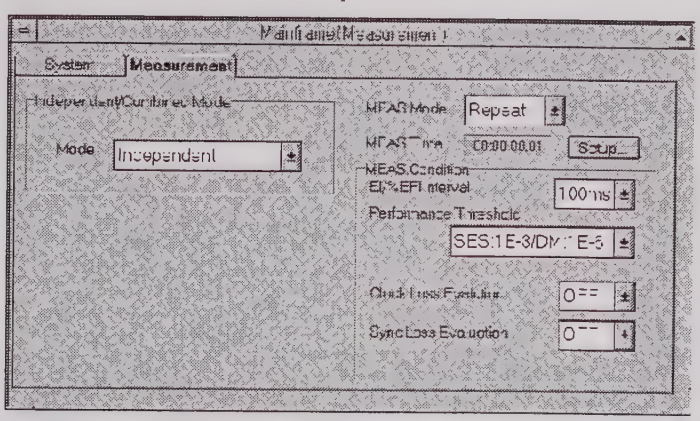


Fig. 5-1 The Mainframe: Measurement panel

2. Select one from the Mode dropdown list of the Independent/Combined Mode group box.

Independent	Sets the independent measurement mode for each CH.
2CH Combined	Sets the measurement mode to provide correlation in the pair of CH1 and CH3 and the pair of CH2 and CH4.
4CH Combined	Sets the measurement mode to provide correlation among CH1 thru CH4.

3. The message dialog box is displayed to urge saving data to the file, because the PRGM edit pattern (edited until then) is initialized when the mode is switched between Independent/Combined Modes.
   Press the OK button to enable the setup.
   Press the Cancel button to return it to the previous status.

Notes:

1. The settings for the pattern setting, the synchronization setting, and the error detection mode setting (the settings of the Pattern group box and the Test Menu group box of the CH sub-window) are held for each of the Independent/Combined Modes. Therefore, the above settings are switched to the setting condition of the mode after the change when a setting is changed. (For example, when Independent mode is changed to 2CH Combined mode, the status of Independent is held inside and the setting status on the screen is changed to the status of 2CH Combined).

2. When a mode is changed, the PRGM edit pattern is initialized, because the PRGM status in each mode cannot be held. So, PRGM Pattern Length, Pattern Sync Mode, and Frame Length are initialized. Initial values are shown in the following table:

Item \ Mode after changed	Independent	2CH Combined	4CH Combined
PRGM Pattern Length	2	4	8
PRGM edit pattern	ALL0	ALL0	ALL0
Pattern Sync Mode	Normal	Normal	Normal
Frame Length	8 bits	16 bits	32 bits

5.2 Setting Data Input Interface

Procedures to set the date input interface are explained here.
These are the items to set data input interface:

- Data input level setup
- Data input Threshold level setup
- Data input termination condition setup

Data input interfaces are set for each CH. Each CH setting is performed in the sub-window corresponding to it (the CH1, CH2, CH3, or CH4 sub-windows).
Since the setting method and ranges are the same for all CHs, an example setup of Data input interface of CH1 is explained here.

Procedure:

1. Open the CH1 sub-window.

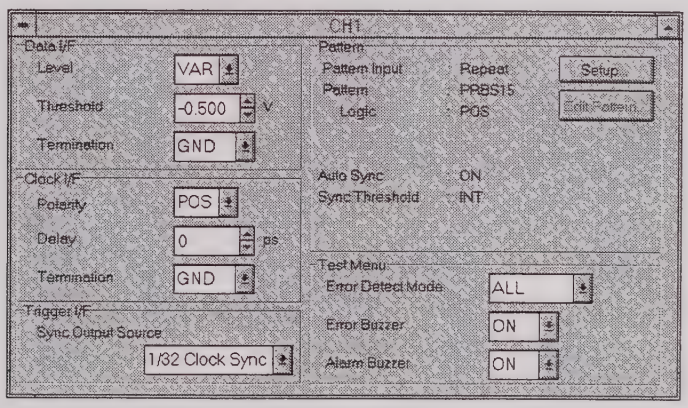


Fig. 5-2 The CH1 sub-window

2. Set the Data input level. Select one from the Level dropdown list in the Data I/F group box.
   At this time, the confirmation message dialog box is displayed to check the set-up change in order to prevent damage of DUT (device under test) by erroneous operation. Press the OK button to enable setup. Press the Cancel button to return the setup to the previous condition.

VAR	Sets any level.
ECL	Sets the ECL level. The ECL level ···· High: –0.9 V, Low: –1.7 V, Threshold: –1.3 V

3. Set the Data input Threshold level, as below. Input the level in the Threshold spin box of the Data I/F group box.

–3.000 to +1.750 V	step: 0.001 V

4. Set the termination condition for the Data input, as below. Select one from the Termination dropdown list of the Data I/F group box.
At this time, the confirmation message dialog box is displayed to check the set-up change in order to prevent hardware damage by erroneous operation.
Press the OK button to enable the setup. Press the Cancel button to return the setup to the previous condition.

GND	Sets the grounded termination.
–2 V	Sets the ECL level.

Note:

The Data input interface can be independently set for each CH every time, regardless of Independent/Combined Modes.

5.3 Setting Clock Input Interface

Procedures to set the Clock input interface are explained here.
These are the items to setup the Clock input interface:

- Clock input polarity setup
- Clock input delay setup
- Clock input termination condition setup

Clock input interfaces are set for each CH. Each CH is set in the sub-window corresponding to it (the CH1, CH2, CH3, and CH4 sub-windows).
Since the setting methods and the range are the same for all CHs, an example setup of Clock input interface of CH1 is explained here.

Procedure:

1. Open the CH1 sub-window.

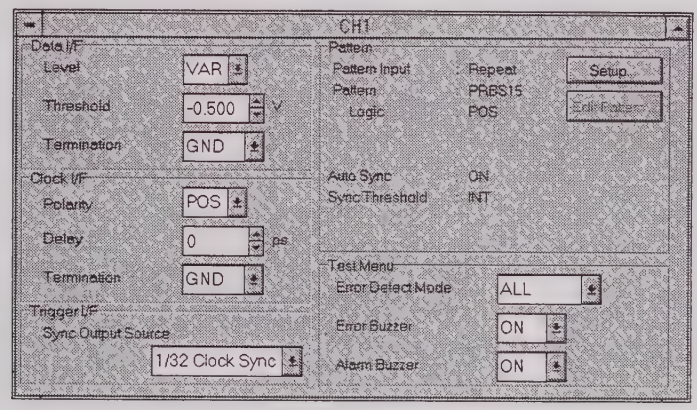


Fig. 5-3 The CH1 sub-window

2. Set the Clock input polarity, as below. Select one from the Polarity dropdown list of the Clock I/F group box.

POS	Sets the polarity to positive logic.
NEG	Sets the polarity to negative logic.

3. Set the Clock input delay, as below. Input the delay value in the Delay spin box of the Clock I/F group box.

–500 to +500 ps	step: 1 ps

4. Set the termination condition for Clock input, as below.
   Select one from the Termination dropdown list for the Clock I/F group box.
   At this time, the confirmation message dialog box is displayed to check the set-up change in order to prevent device under test (DUT) damage by erroneous operation.
   Press the OK button to enable the setup.
   Press the Cancel button to return the setup to the previous status.

GND	Sets the grounded termination.
–2 V	Sets the ECL level.
	The ECL level ·····High: –0.9 V, Low: –1.7 V

Notes:

1. The Clock input interface can be independently set for each CH every time, regardless of the Independent/Combined Modes.

2. The Clock input delay setup takes several hundred ms before the delay is set in the hardware, after the set value is changed on the screen. Therefore, the Delay Busy lamp is turned ON (during the interval from the time when the delay setup is made on the screen till the delay is set in the hardware (Delay Busy status)) to indicate that the delay is not set.

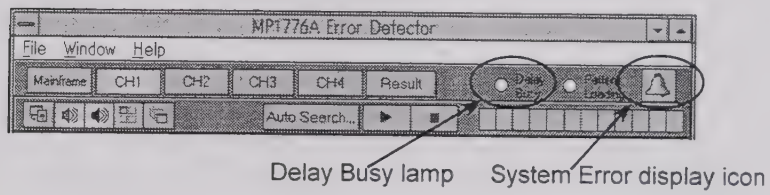


Fig. 5-4 Delay Busy lamp and System Error display icon

   In addition, the System Error display icon appears to indicate the delay failure, if delay trouble occurs in the hardware that sets the delay.
   Clicking the icon opens the System Error dialog box to display the CH where the Delay Trouble occurred.

3. The following operations cannot be performed during the Delay Busy status after setting the Clock input delay:

   - Auto Search
   - Measurement start
   - Measurement stop

5.4 Setting Reception Pattern

5.4.1 Setting reception pattern

The reception pattern setup is explained here.
Pattern setups are roughly divided into the followings. See the section corresponding to the setting item.

- Reception mode setup
  The reception pattern is set as the continuous pattern or the burst pattern.
  ..... See 5.4.2 "Setting reception mode".
- Reception pattern type setup
  The type of reception pattern is set.
  Pattern types are roughly divided into the following three:
  PRBS pattern..... See 5.4.3 "Setting PRBS pattern".
  PRGM pattern..... See 5.4.4 "Setting PRGM pattern".
  Zero-Subst pattern..... See 5.4.5 "Setting Zero-Subst pattern".

In addition, the reception patterns are set for each CH (see Notes below for setting in Combined mode). Each CH is set in the sub-window corresponding to it (the CH1, CH2, CH3, or CH4 sub-window).
Since the setting method and the range are the same for all CHs, an example setup of reception pattern of CH1 is explained here.

Notes:

1. Reception patterns are set as follows, according to the Independent/Combined Modes:

   Independent: Each CH can be independently set.
   2CH Combined: The same setup is applied for each the pair of the CH1 and CH3 and the pair of CH2 and CH4.
   The either of the CH setup change is reflected in the other CH setup.
   4CH Combined: The same setup is applied to all CHs. One CH setup change is reflected in the other three CH setup.

2. Measurement is re-started when a setup of the reception pattern is changed during measurement.

5.4.2 Setting reception mode

The reception pattern is set as a continuous pattern or a burst pattern.
Setup is explained using a setting example of the reception mode for CH1.

Procedure:

1. Open the CH1 sub-window.

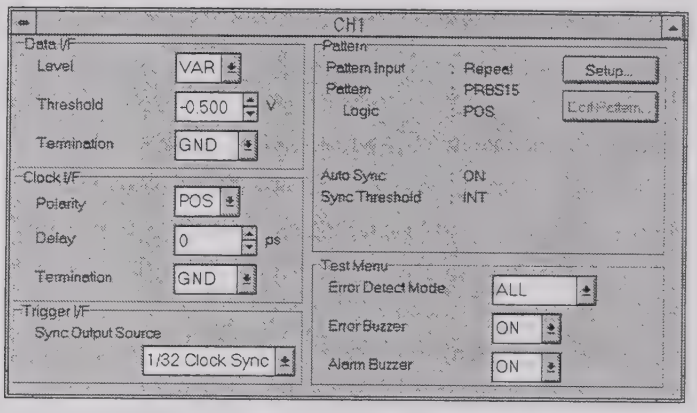


Fig. 5-5 CH1 sub-window

2. Press the Setup... button in the Pattern group box of the CH1 sub-window. The Pattern dialog box is opened.

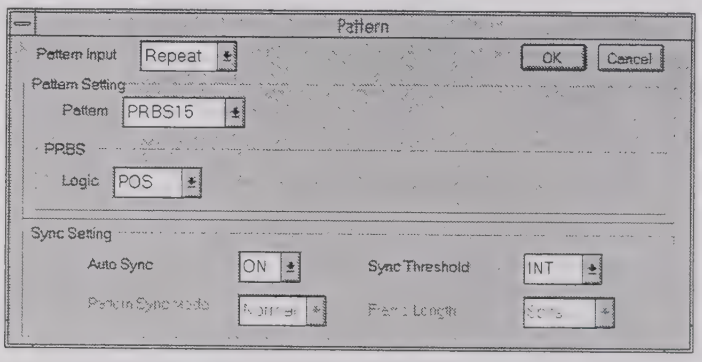


Fig. 5-6 Pattern dialog box

3. Select one from the Pattern Input dropdown list.

Repeat	Sets the status to receive a continuous pattern.
Burst	Sets the status to receive a burst pattern.

4. The setup is completed. Press the OK button to enable the setup.

Note:

The Resync signal must be input from outside to establish the synchronization with the burst period when the reception pattern is the burst pattern. The data-enable interval is judged by using the Resync signal.

5.4.3 Setting PRBS pattern

Sets the reception pattern type to PRBS pattern.
These are the items for setup relating to the PRBS pattern:

- Setup of the number of PRBS stages
- Setup of pattern logic

Setup procedure is explained using a example to set the PRBS pattern for CH1.

Procedure:

1. Open the CH1 sub-window.
2. Press the Setup... button in the Pattern group box for the CH1 sub-window.
   The Pattern dialog box is opened.

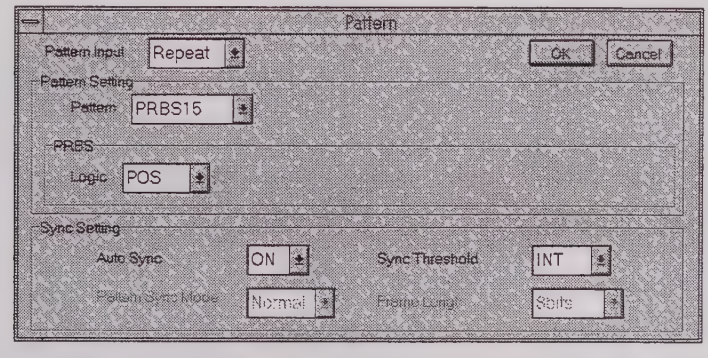


Fig. 5-7 Pattern dialog box (case of PRBS)

3. Set the PRBS pattern, as follows.
   Select one from the Pattern dropdown list of the Pattern Setting group box.

PRBS7	Sets the pattern to PRBS of 2^7-1.
PRBS9	Sets the pattern to PRBS of 2^9-1.
PRBS11	Sets the pattern to PRBS of $2^{11}-1$.
PRBS15	Sets the pattern to PRBS of $2^{15}-1$.
PRBS20	Sets the pattern to PRBS of $2^{20}-1$.
PRBS23	Sets the pattern to PRBS of $2^{23}-1$.
PRBS31	Sets the pattern to PRBS of $2^{31}-1$.

4. Set the logic for PRBS pattern, as below.
   Select one from the Logic dropdown list of the PRBS group box.

POS	Sets the pattern logic to the positive logic.
NEG	Sets the pattern logic to the negative logic.

5. The setup is completed. Press OK button to enable the setup.
   Press Cancel button to return to the previous setup.

5.4.4 Setting PRGM pattern

Sets the reception pattern type to the PRGM pattern.
These are the items for setup relating to the PRGM pattern:

- PRGM pattern length setup
- Pattern logic setup
- PRGM pattern data edit ... See 5.5 "Editing PRGM Pattern " for the edit method.

Setup procedure is explained using an example to set the PRGM pattern of CH1.

Procedure:

1. Open the CH1 sub-window.
2. Press the Setup... button in the Pattern group box of the CH1 sub-window.
   The Pattern dialog box is opened.

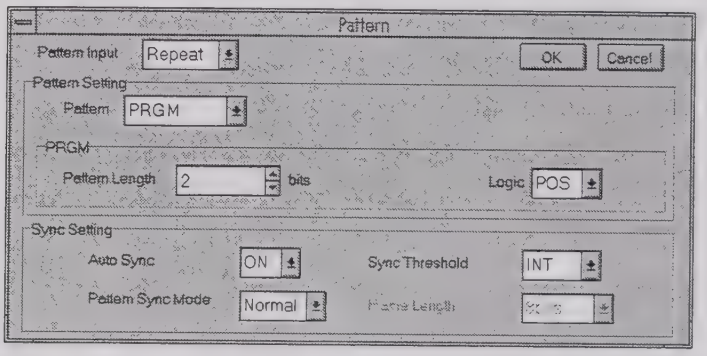


Fig. 5-8 Pattern dialog box (case of PRGM)

3. Set the PRGM pattern, as below. Select one from the Pattern dropdown list of the Pattern Setting group box.

4. Set the PRGM pattern length, as below. Set the length in the Pattern Length spin box of the PRGM group box. This setup range is different, depending on the Independent/Combined mode.

<The case of Independent mode>

2	to	65,536 bits	step:	1 bit
65,536	to	131,072 bits	step:	2 bits
131,072	to	262,144 bits	step:	4 bits
262,144	to	524,288 bits	step:	8 bits
524,288	to	1,048,576 bits	step:	16 bits
1,048,576	to	2,097,152 bits	step:	32 bits
2,097,152	to	4,194,304 bits	step:	64 bits
4,194,304	to	8,388,608 bits	step:	128 bits

<The case of 2CH Combined mode>

4	to	131,072 bits	step:	2 bits
131,072	to	262,144 bits	step:	4 bits
262,144	to	524,288 bits	step:	8 bits
524,288	to	1,048,576 bits	step:	16 bits
1,048,576	to	2,097,152 bits	step:	32 bits
2,097,152	to	4,194,304 bits	step:	64 bits
4,194,304	to	8,388,608 bits	step:	128 bits
8,388,608	to	16,777,216 bits	step:	256 bits

<The case of 4CH Combined mode>

8	to	262,144 bits	step:	4 bits
262,144	to	524,288 bits	step:	8 bits
524,288	to	1,048,576 bits	step:	16 bits
1,048,576	to	2,097,152 bits	step:	32 bits
2,097,152	to	4,194,304 bits	step:	64 bits
4,194,304	to	8,388,608 bits	step:	128 bits
8,388,608	to	16,777,216 bits	step:	256 bits
16,777,216	to	33,554,432 bits	step:	512 bits

5. Set the logic of PRGM pattern, as below. Select one from the Logic dropdown list of the PRGM group box.

POS	Sets the pattern logic to positive logic.
NEG	Sets the pattern logic to negative logic.

6. The setup is completed. Press the OK button to enable setup.
Press Cancel button to return to the previous setup.
See 5.5 "Editing PRGM Pattern" when editing the PRGM pattern.

Notes:

1. After the setup is confirmed on the window (except for the Logic setup), the PRGM pattern setup may take several seconds before the internal hardware is set. Therefore, the Pattern Loading lamp is turned ON to indicate that the hardware is not set at the Pattern Loading interval (from the time when the setup is set on the window till the time when the internal hardware is set).

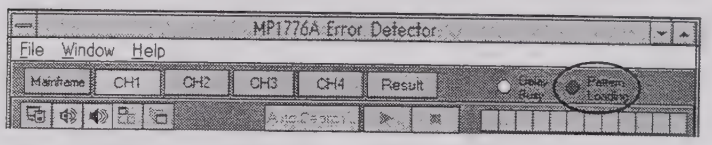


Fig. 5-9 The Pattern Loading lamp

2. The following operations cannot be executed in the Pattern Loading interval after the PRGM pattern setup on the window.

   - Auto Search
   - Measurement start
   - Measurement stop

5.4.5 Setting Zero-Subst pattern

Sets the type of the reception pattern to the Zero-Subst pattern.
These are the items for setup relating to the Zero-Subst pattern:

- Pattern length setup
- 0-bit insertion length setup
- Pattern logic setup

Setup procedure is explained using an example to set the Zero-Subst pattern of CH1.

Procedure:

1. Open the CH1 sub-window.
2. Press the Setup... button in the Pattern group box of the CH1 sub-window. The Pattern dialog box is opened.

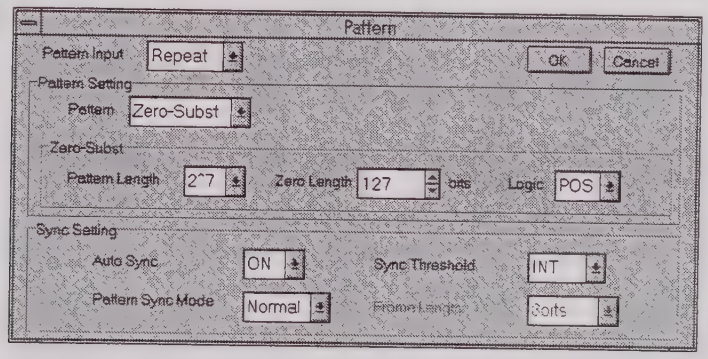


Fig. 5-10 Pattern dialog box (case of Zero-Subst)

3. Set the Zero-Subst pattern, as below. Select one from the Pattern dropdown list of the Pattern Setting group box.
4. Set the Zero-Subst pattern length, as below. Select one from the Pattern Length dropdown list of the Zero-Subst group box.

2^7	Sets the pattern length to 2^7.
2^9	Sets the pattern length to 2^9.
2^11	Sets the pattern length to 2^11.
2^15	Sets the pattern length to 2^15.

5. Set the 0-bit insertion length, as below. Select one from the Zero Length spin box of the Zero-Subst group box. The setting range of 0-bit insertion length is different, depending on the pattern length, as shown below.

The case of 2^7	7	to	127 bits	Step: 1 bit
The case of 2^9	9	to	511 bits	Step: 1 bit
The case of 2^11	11	to	2047 bits	Step: 1 bit
The case of 2^15	15	to	32767 bits	Step: 1 bit

6. Set the logic of Zero-Subst pattern, as below. Select one from the Logic dropdown list of the Zero-Subst group box.

POS	Sets the pattern logic to positive logic.
NEG	Sets the pattern logic to negative logic.

7. The setup is completed. Press the OK button to enable the setup. Press Cancel button to return to the previous setup.

5.5 Editing PRGM Pattern

5.5.1 Displaying pattern editor

The Pattern Editor dialog box is used to edit the PRGM pattern when the reception pattern is PRGM. Editing the PRGM pattern using the Pattern Editor dialog box is explained here.

The PRGM pattern is edited for each CH. Each CH is set in the sub-window corresponding to it (the CH1, CH2, CH3, and CH4 sub-windows).
Since the setting methods and the range are the same for all CHs, an example setup of PRGM pattern for CH1 is explained here.

Procedure:

1. Open the CH1 sub-window. Set the reception pattern to the PRGM pattern, according to the procedures for 5.4.4 "Setting PRGM pattern".

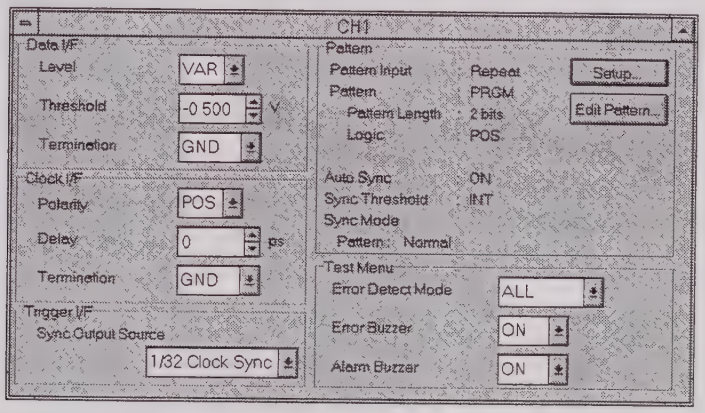


Fig. 5-11 CH1 sub-window

2. Press the Edit Pattern... button of the Pattern group box. The Pattern Editor dialog box is opened.

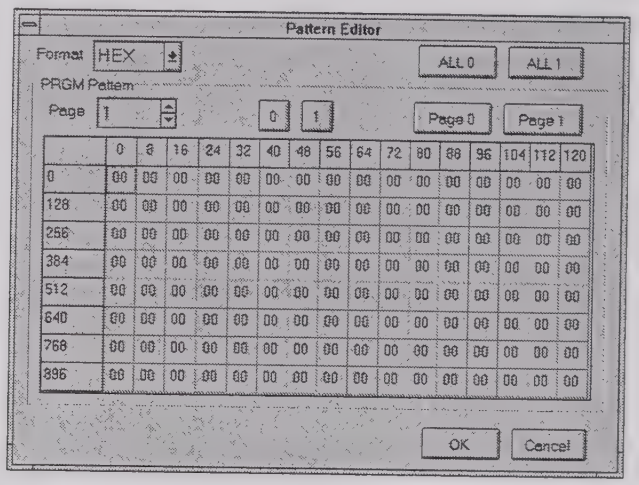


Fig. 5-12 Pattern Editor dialog box

3. Set the display format for edit screen, as below. Select one from the Format dropdown list.

BIN	Displays in the binary format.
HEX	Displays in the hexadecimal format.

4. The display is switched per page in the Pattern Editor. Set the page to edit in the Page spin box of the PRGM Pattern group box.

1 to Max page, Step: 1

Max = Pattern Length ÷ 128 (Format: BIN)

Max = Pattern Length ÷ 1024 (Format: HEX)

*Pattern Length = Pattern length of PRGM pattern

Note:

One page is defined in the Pattern Editor according to the Format, as follows:

Format: BIN, pattern of 128 bits

Format: HEX, pattern of 1024 bits

5. Edit the PRGM pattern. For edit operation, see 5.5.2 "Edit operation using Pattern Editor".

6. The setup is completed. Press the OK button to enable the setup. Press the Cancel button to return to the previous setup.

5.5.2 Edit operation using Pattern Editor

These are the methods to edit patterns using the Pattern Editor:

- Edit button
- The dialog box to input patterns (when Format is HEX)
- Panel key input

Each of the edit methods is explained here.

Edit button

The Pattern Editor has buttons for editing.

ALL0 button	Sets all patterns to 0. The warning message is displayed to confirm the operation when the button is pressed.
ALL1 button	Sets all patterns to 1. The warning message is displayed to confirm the operation when the button is pressed.
Page0 button	Sets all patterns of the displayed page to 0. 128 bits are used per page when the Format is BIN. 1024 bits are used per page when the Format is HEX.
Page1 button	Sets all patterns of the displayed page to 1. 128 bits are used per page when the Format is BIN. 1024 bits are used per page when the Format is HEX.
0 button	Sets the selected pattern to 0. The 1-bit unit can be selected when the Format is BIN. The 1-byte unit can be selected when the Format is HEX. The pattern can be selected by clicking the pattern displayed.
1 button	Sets the selected pattern to 1. The 1-bit unit can be selected when the Format is BIN. The 1-byte unit can be selected when the Format is HEX. The pattern can be selected by clicking the pattern displayed. The selected pattern is set to FF when the Format is HEX.

Dialog box to input patterns

When the HEX pattern to be edited is double-clicked, the Pattern dialog box is displayed.

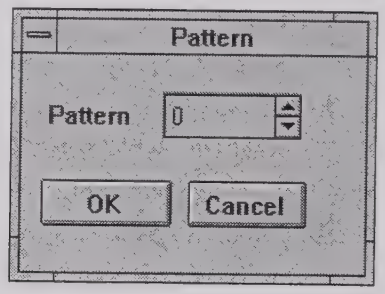


Fig. 5-13 Pattern dialog box

1. Input the data you want to set in the Pattern spin box. Use spin buttons, front panel keys and external keyboard for input.
2. The setup is completed. Press the OK button to enable the setup. The selected pattern is changed to the new value input in the Pattern dialog box.

Key input

The setup value can be input directly to the Pattern Editor by using front panel keys and the external keyboard.

Select the pattern you want to edit, and input a numerical value. Press the Enter key at the end of the key input to confirm the input numerical value.

The input using the following keys is enabled, according to the Format:

BIN format	0 and 1 keys
HEX format	0 to 9 and A to F keys

5.6 Setting Sync Output

Procedures are explained here to select the signal that are output from the Sync Output connector.

Sync Output signal setting is performed for each CH. Each CH is set in the sub-window corresponding to it (the CH1, CH2, CH3, and CH4 sub-windows).
Since the setting method and the range are the same for all CHs, an example setup of Sync Output for CH1 is explained here.

Procedure:

1. Open the CH1 sub-window.

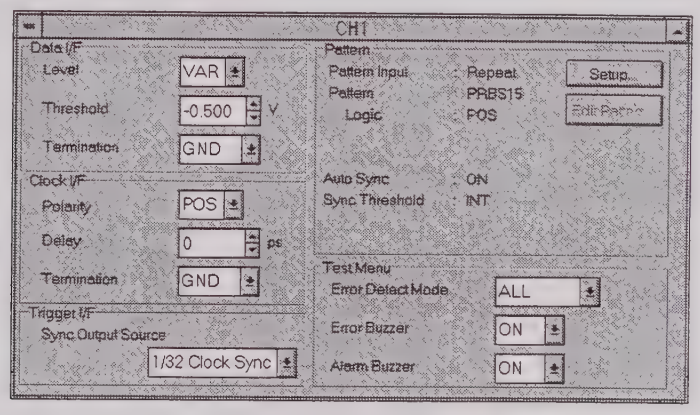


Fig. 5-14 CH1 sub-window

2. Set the output signal for Sync Output, as below.
   Select one from the Sync Output dropdown list of the Trigger I/F group box.

Pattern Sync	The pulse signal of 8-bit width synchronized with the pattern is output. For the details of the output signal, see Appendix C.
1/32 Clock Sync	The 1/32-divided Clock signal is output.

3. The setup is completed.

5.7 Setting Synchronization of Reception Pattern

The MP1776A is equipped with the Auto Sync function to automatically synchronize the input pattern to the reference pattern inside the ED unit during measurement, to prevent the excessive error occurrence due to the period deviation.

These are the setups for pattern synchronization:

- Set ON/OFF of the Auto Sync function.
- Set the threshold value for the judgment of sync loss and the sync recovery.
  It is judged to be the sync loss status when the error rate exceeds the sync loss threshold value in the sync gain status.
  In addition, it is judged to be the sync gain status when the error rate is the sync recovery threshold value or less in the sync loss status.

In addition, there are not only the above setups but also the following setups, when the reception pattern is the PRGM pattern or the Zero-Subst pattern:

- Pattern synchronization method
  Set the pattern synchronizing method of either synchronizing by frame-bit monitoring with a part of the pattern as frame bits or synchronizing by one-period pattern monitoring.
- Frame bit-length setup
  Set the number of frame bits to be counted from the top of the pattern when the synchronization method is the frame.

In addition, the pattern synchronization is set for each CH. (for the case of Combined modes, see Note bellow). Each CH is set in the sub-window corresponding to it (the CH1, CH2, CH3, and CH4 sub-windows).
Since the setting methods and the range are the same for all CHs, an example setup of pattern synchronization of CH1 is explained here.

Note:

The above patterns are set as follows, according to the Independent/Combined Modes:

Independent	Each CH can be independently set.
2CH Combined	The same setup is applied for each the pair of CH1 and CH3 and the pair of CH2 and CH4. When either one of the CH setups is changed, the setup change is reflected in the other CH.
4CH Combined	The same setup is applied to all CHs. When one of CH setups is changed, the setup change is reflected in the other three CHs.

1. Open the CH1 sub-window.
2. Press the Setup... button in the Pattern group box of the CH1 sub-window.
   The Pattern dialog box is opened.

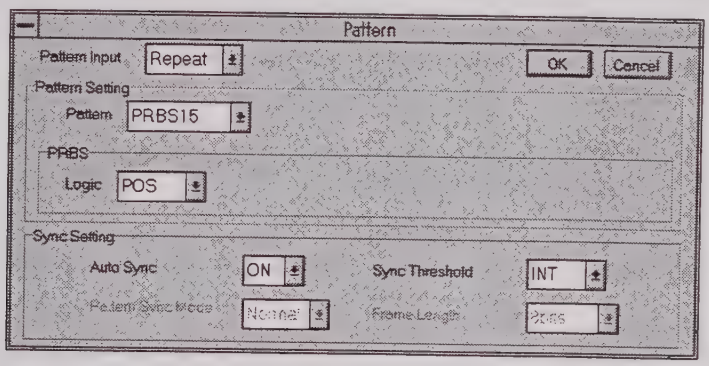


Fig. 5-15 Pattern dialog box

3. Set ON/OFF of the Auto Sync function, as below. Select one from the Auto Sync dropdown list of the Sync Setting group box.
4. Set the sync loss threshold and the sync recovery threshold, as below.
   Select one from the Sync Threshold dropdown list of the Sync Setting group box.
   See Table 5-1 "Sync threshold" for the threshold value of actual judgment.

INT	Uses the values internally held by the MP1776A for thresholds of the sync loss and the sync recovery.
E-2, E-3, E-4, E-5, E-6, E-7, E-8	Sets each value of the threshold.

5. Sets the pattern synchronization method when the reception pattern is PRGM or Zero-Subst, as below. Select one from the Pattern Sync Mode dropdown list box in the Sync Setting group box.

Normal	Synchronizes the pattern by monitoring the pattern for 1 period.
Frame	Synchronizes the pattern by using the specified frame bit. The frame bit is set from the top of the PRGM pattern and the Zero-Subst pattern.

Notes:

1. Frame can be selected when the PRGM pattern lengths are as shown below in the case of the PRGM reception pattern. The restricting condition of Frame selection depends on Independent/Combined Modes, as below.

   Independent mode: 128 bits or more
   2CH Combined mode: 256 bits or more
   4CH Combined mode: 512 bits or more

2. At Frame synchronization using frame bits, the synchronization may take time because of the possibility of erroneous synchronization due to the presence of the same pattern as the frame bit at other positions.

6. Set the frame bit length, as below. Select one from the FrameLength drop-down list box inside the Sync Setting group box. The setup range depends on Independent/Combined Modes, as below.

<Independent mode>.	
8 bits, 16 bits, 24 bits, 32 bits	Specify the frame length at each bit.
<2CH Combined mode>	
16 bits, 32 bits, 48 bits, 64 bits	Specify the frame length at each bit.
<4CH Combined mode>	
32 bits, 64 bits, 96 bits, 128 bits	Specify the frame length at each bit.

7. The setup is completed. Press the OK button to enable the setup. Press Cancel button to return to the previous setup.

Table 5-1-1 Synchronization threshold (for INT/Independent)

MODE	Pattern	Length	Synchronization threshold $\text{Error rate} = \frac{\text{Number of errors}}{\text{Number of clock counts}}$	
			From synchronization gain status to synchronization loss status	From synchronization loss status to synchronization gain status
Normal	PRBS	2^N-1 (N=7, 9, 11, 15, 20, 23, 31)	$\frac{(128)\times 2{,}000}{(512)\times 10{,}000} = 5\times 10^{-2}$	$\frac{(64)\times 1}{(512)\times 8} = 1.56\times 10^{-2}$
	PRGM /Zero-Subst	2 to 16	$\frac{(128)\times 2{,}000}{(512)\times 10{,}000} = 5\times 10^{-2}$	$\frac{(64)\times 1}{(512)\times 8} = 1.56\times 10^{-2}$
		17 to 160	$\frac{(128)\times 200}{(512)\times 10{,}000} = 5\times 10^{-3}$	$\frac{(64)\times 1}{(512)\times 80} = 1.56\times 10^{-3}$
		161 to 1,600	$\frac{(128)\times 20}{(512)\times 10{,}000} = 5\times 10^{-4}$	$\frac{(64)\times 1}{(512)\times 800} = 1.56\times 10^{-4}$
		1,601 to 16,000	$\frac{(128)\times 2}{(512)\times 10{,}000} = 5\times 10^{-5}$	$\frac{(64)\times 1}{(512)\times 8{,}000} = 1.56\times 10^{-5}$
		16,001 to 80,000	$\frac{(128)\times 2}{(512)\times 50{,}000} = 1\times 10^{-5}$	$\frac{(64)\times 1}{(512)\times 20{,}000} = 6.25\times 10^{-6}$
		80,001 to 160,000	$\frac{(128)\times 2}{(512)\times 100{,}000} = 5\times 10^{-6}$	$\frac{(64)\times 1}{(512)\times 40{,}000} = 3.13\times 10^{-6}$
		160,001 to 320,000	$\frac{(128)\times 2}{(512)\times 200{,}000} = 2.5\times 10^{-6}$	$\frac{(64)\times 1}{(512)\times 80{,}000} = 1.56\times 10^{-6}$
		32,001 to 524,288	$\frac{(128)\times 2}{(512)\times 2^{18}} = 1.9\times 10^{-6}$	$\frac{(64)\times 1}{(512)\times 160{,}000} = 7.81\times 10^{-7}$
		524,289 to 1,048,576	$\frac{(128)\times 2}{(512)\times 2^{19}} = 9.54\times 10^{-7}$	$\frac{(64)\times 1}{(512)\times 320{,}000} = 3.91\times 10^{-7}$
		1,048,577 to 2,097,152	$\frac{(128)\times 2}{(512)\times 2^{20}} = 4.77\times 10^{-7}$	$\frac{(64)\times 1}{(512)\times 640{,}000} = 1.96\times 10^{-7}$
		2,097,153 to 4,194,304	$\frac{(128)\times 2}{(512)\times 2^{21}} = 2.38\times 10^{-7}$	$\frac{(64)\times 1}{(512)\times 1{,}280{,}000} = 9.80\times 10^{-8}$
		4,194,305 to 8,388,608	$\frac{(128)\times 2}{(512)\times 2^{22}} = 1.19\times 10^{-7}$	$\frac{(64)\times 1}{(512)\times 2{,}560{,}000} = 4.90\times 10^{-8}$
Frame	PRGM /Zero-Subst	128 to 5,120	$\frac{(128)\times 100}{(512)\times 150{,}000} = 1.7\times 10^{-4}$	$\frac{(64)\times 1}{(512)\times N/8}$ N = Length
		5,121 to 10,240	$\frac{(128)\times 100}{(512)\times 275{,}000} = 9.1\times 10^{-5}$	
		10,241 to 51,200	$\frac{(128)\times 100}{(512)\times 1{,}300{,}000} = 1.9\times 10^{-5}$	
		51,201 to 102,400	$\frac{(128)\times 100}{(512)\times 2{,}750{,}000} = 9.1\times 10^{-6}$	
		102,401 to 204,800	$\frac{(128)\times 100}{(512)\times 5{,}250{,}000} = 4.8\times 10^{-6}$	
		204,801 to 307,200	$\frac{(128)\times 100}{(512)\times 7{,}750{,}000} = 3.2\times 10^{-6}$	
		307,201 to 409,600	$\frac{(128)\times 100}{(512)\times 10{,}250{,}000} = 2.4\times 10^{-6}$	
		409,601 to 524,288	$\frac{(128)\times 100}{(512)\times 13{,}250{,}000} = 1.9\times 10^{-6}$	
		524,289 to 1,048,576	$\frac{(128)\times 100}{(512)\times 27{,}500{,}000} = 9.1\times 10^{-7}$	
		1,048,577 to 2,097,152	$\frac{(128)\times 100}{(512)\times 52{,}500{,}000} = 4.8\times 10^{-7}$	
		2,097,153 to 4,194,304	$\frac{(128)\times 100}{(512)\times 105{,}000{,}000} = 2.4\times 10^{-7}$	
		4,194,305 to 8,388,608	$\frac{(128)\times 100}{(512)\times 210{,}000{,}000} = 1.2\times 10^{-7}$	

Table 5-1-2 Synchronization threshold (for INT/2CH and 4CH Combined)

MODE	Pattern	Length	Synchronization threshold Error rate = Number of errors / Number of clock counts			
			From synchronization gain status to synchronization loss status		From synchronization loss status to synchronization gain status	
			4CH Combined	2CH Combined	4CH Combined	2CH Combined
Normal	PRBS	2^N-1 (N=7, 9, 11, 15, 20, 23, 31)	$\frac{(512)\times 2,000}{(2048)\times 10,000}=5\times10^{-2}$	$\frac{(256)\times 2,000}{(1024)\times 10,000}$	$\frac{(256)}{(2048)\times 8}=1.56\times10^{-2}$	$\frac{(128)\times 1}{(1024)\times 8}$
	PRGM /Zero-Subst	2 to 16	$\frac{(512)\times 2,000}{(2048)\times 10,000}=5\times10^{-2}$	$\frac{(256)\times 2,000}{(1024)\times 10,000}$	$\frac{(256)}{(2048)\times 8}=1.56\times10^{-2}$	$\frac{(128)\times 1}{(1024)\times 8}$
		17 to 160	$\frac{(512)\times 200}{(2048)\times 10,000}=5\times10^{-3}$	$\frac{(256)\times 200}{(1024)\times 10,000}$	$\frac{(256)}{(2048)\times 80}=1.56\times10^{-3}$	$\frac{(128)\times 1}{(1024)\times 80}$
		161 to 1,600	$\frac{(512)\times 20}{(2048)\times 10,000}=5\times10^{-4}$	$\frac{(256)\times 20}{(1024)\times 10,000}$	$\frac{(256)}{(2048)\times 800}=1.56\times10^{-4}$	$\frac{(128)\times 1}{(1024)\times 800}$
		1,601 to 16,000	$\frac{(512)\times 2}{(2048)\times 10,000}=5\times10^{-5}$	$\frac{(256)\times 2}{(1024)\times 10,000}$	$\frac{(256)}{(2048)\times 8,000}=1.56\times10^{-5}$	$\frac{(128)\times 1}{(1024)\times 8,000}$
		16,001 to 80,000	$\frac{(512)\times 2}{(2048)\times 50,000}=1\times10^{-5}$	$\frac{(256)\times 2}{(1024)\times 50,000}$	$\frac{(256)}{(2048)\times 20,000}=6.25\times10^{-6}$	$\frac{(128)\times 1}{(1024)\times 20,000}$
		80,001 to 160,000	$\frac{(512)\times 2}{(2048)\times 100,000}=5\times10^{-6}$	$\frac{(256)\times 2}{(1024)\times 100,000}$	$\frac{(256)}{(2048)\times 40,000}=3.13\times10^{-6}$	$\frac{(128)\times 1}{(1024)\times 40,000}$
		160,001 to 320,000	$\frac{(512)\times 2}{(2048)\times 200,000}=2.5\times10^{-6}$	$\frac{(256)\times 2}{(1024)\times 200,000}$	$\frac{(256)}{(2048)\times 80,000}=1.56\times10^{-6}$	$\frac{(128)\times 1}{(1024)\times 80,000}$
		32,001 to 524,288	$\frac{(512)\times 2}{(2048)\times 2^{18}}=1.9\times10^{-6}$	$\frac{(256)\times 2}{(1024)\times 2^{18}}$	$\frac{(256)}{(2048)\times 160,000}=7.81\times10^{-7}$	$\frac{(128)\times 1}{(1024)\times 160,000}$
		524,289 to 1,048,576	$\frac{(512)\times 2}{(2048)\times 2^{19}}=9.54\times10^{-7}$	$\frac{(256)\times 2}{(1024)\times 2^{19}}$	$\frac{(256)}{(2048)\times 320,000}=3.91\times10^{-7}$	$\frac{(128)\times 1}{(1024)\times 320,000}$
		1,048,577 to 2,097,152	$\frac{(512)\times 2}{(2048)\times 2^{20}}=4.77\times10^{-7}$	$\frac{(256)\times 2}{(1024)\times 2^{20}}$	$\frac{(256)}{(2048)\times 640,000}=1.96\times10^{-7}$	$\frac{(128)\times 1}{(1024)\times 640,000}$
		2,097,153 to 4,194,304	$\frac{(512)\times 2}{(2048)\times 2^{21}}=2.38\times10^{-7}$	$\frac{(256)\times 2}{(1024)\times 2^{21}}$	$\frac{(256)}{(2048)\times 1,280,000}=9.80\times10^{-8}$	$\frac{(128)\times 1}{(1024)\times 1,280,000}$
		4,194,305 to 8,388,608	$\frac{(512)\times 2}{(2048)\times 2^{22}}=1.19\times10^{-7}$	$\frac{(256)\times 2}{(1024)\times 2^{22}}$	$\frac{(256)}{(2048)\times 2,560,000}=4.90\times10^{-8}$	$\frac{(128)\times 1}{(1024)\times 2,560,000}$
Frame	PRGM /Zero-Subst	128 to 5,120	$\frac{(512)\times 100}{(2048)\times 150,000}=1.7\times10^{-4}$	$\frac{(256)\times 100}{(1024)\times 150,000}$	$\frac{1}{N}$ N = Length $=\frac{(256)}{(64)\times 4N}=\frac{(64)}{(2048)\times N/8}$	$\frac{(128)\times 1}{(1024)\times N/8}$
		5,121 to 10,240	$\frac{(512)\times 100}{(2048)\times 275,000}=9.1\times10^{-5}$	$\frac{(256)\times 100}{(1024)\times 275,000}$		
		10,241 to 51,200	$\frac{(512)\times 100}{(2048)\times 1,300,000}=1.9\times10^{-5}$	$\frac{(256)\times 100}{(1024)\times 1,300,000}$		
		51,201 to 102,400	$\frac{(512)\times 100}{(2048)\times 2,750,000}=9.1\times10^{-6}$	$\frac{(256)\times 100}{(1024)\times 2,750,000}$		
		102,401 to 204,800	$\frac{(512)\times 100}{(2048)\times 5,250,000}=4.8\times10^{-6}$	$\frac{(256)\times 100}{(1024)\times 5,250,000}$		
		204,801 to 307,200	$\frac{(512)\times 100}{(2048)\times 7,750,000}=3.2\times10^{-6}$	$\frac{(256)\times 100}{(1024)\times 7,750,000}$		
		307,201 to 409,600	$\frac{(512)\times 100}{(2048)\times 10,250,000}=2.4\times10^{-6}$	$\frac{(256)\times 100}{(1024)\times 10,250,000}$		
		409,601 to 524,288	$\frac{(512)\times 100}{(2048)\times 13,250,000}=1.9\times10^{-6}$	$\frac{(256)\times 100}{(1024)\times 13,250,000}$		
		524,289 to 1,048,576	$\frac{(512)\times 100}{(2048)\times 27,500,000}=9.1\times10^{-7}$	$\frac{(256)\times 100}{(1024)\times 27,500,000}$		
		1,048,577 to 2,097,152	$\frac{(512)\times 100}{(2048)\times 52,500,000}=4.8\times10^{-7}$	$\frac{(256)\times 100}{(1024)\times 52,500,000}$		
		2,097,153 to 4,194,304	$\frac{(512)\times 100}{(2048)\times 105,000,000}=2.4\times10^{-7}$	$\frac{(256)\times 100}{(1024)\times 105,000,000}$		
		4,194,305 to 8,388,608	$\frac{(512)\times 100}{(2048)\times 210,000,000}=1.2\times10^{-7}$	$\frac{(256)\times 100}{(1024)\times 210,000,000}$		

Table 5-1-3 Synchronization threshold (for E-2 to E-8/Independent)

Sync Threshold	Synchronization threshold $\text{Error rate} = \frac{\text{Number of errors}}{\text{Number of clock counts}}$	
	From synchronization gain status to synchronization loss status	From synchronization loss status to synchronization gain status
10^{-2}	$\frac{(128)\times 2{,}000}{(512)\times 10{,}000}=5\times10^{-2}$	$\frac{(64)\times 1}{(512)\times 8}=1.56\times10^{-2}$
10^{-3}	$\frac{(128)\times 2{,}000}{(512)\times 100{,}000}=5\times10^{-3}$	$\frac{(64)\times 1}{(512)\times 80}=1.56\times10^{-3}$
10^{-4}	$\frac{(128)\times 2{,}000}{(512)\times 1{,}000{,}000}=5\times10^{-4}$	$\frac{(64)\times 1}{(512)\times 800}=1.56\times10^{-4}$
10^{-5}	$\frac{(128)\times 2{,}000}{(512)\times 10{,}000{,}000}=5\times10^{-5}$	$\frac{(64)\times 1}{(512)\times 8{,}000}=1.56\times10^{-5}$
10^{-6}	$\frac{(128)\times 2{,}000}{(512)\times 100{,}000{,}000}=5\times10^{-6}$	$\frac{(64)\times 1}{(512)\times 80{,}000}=1.56\times10^{-6}$
10^{-7}	$\frac{(128)\times 200}{(512)\times 100{,}000{,}000}=5\times10^{-7}$	$\frac{(64)\times 1}{(512)\times 800{,}000}=1.56\times10^{-7}$
10^{-8}	$\frac{(128)\times 20}{(512)\times 100{,}000{,}000}=5\times10^{-8}$	$\frac{(64)\times 1}{(512)\times 8{,}000{,}000}=1.56\times10^{-8}$

Table 5-1-4 Synchronization threshold (for E-2 to E-8/2CH and 4CH Combined)

Sync Threshold	Synchronization threshold $\text{Error rate} = \frac{\text{Number of errors}}{\text{Number of clock counts}}$			
	From synchronization gain status to synchronization loss status		From synchronization loss status to synchronization gain status	
	4CH Combined	2CH Combined	4CH Combined	2CH Combined
10^{-2}	$\frac{(512)\times 2{,}000}{(2048)\times 10{,}000}=5\times10^{-2}$	$\frac{(256)\times 2{,}000}{(1024)\times 10{,}000}$	$\frac{(512)}{(2048)\times 8}=1.56\times10^{-2}$	$\frac{(128)\times 1}{(1024)\times 8}$
10^{-3}	$\frac{(512)\times 2{,}000}{(2048)\times 100{,}000}=5\times10^{-3}$	$\frac{(256)\times 2{,}000}{(1024)\times 100{,}000}$	$\frac{(512)}{(2048)\times 80}=1.56\times10^{-3}$	$\frac{(128)\times 1}{(1024)\times 80}$
10^{-4}	$\frac{(512)\times 2{,}000}{(2048)\times 1{,}000{,}000}=5\times10^{-4}$	$\frac{(256)\times 2{,}000}{(1024)\times 1{,}000{,}000}$	$\frac{(512)}{(2048)\times 800}=1.56\times10^{-4}$	$\frac{(128)\times 1}{(1024)\times 800}$
10^{-5}	$\frac{(512)\times 2{,}000}{(2048)\times 10{,}000{,}000}=5\times10^{-5}$	$\frac{(256)\times 2{,}000}{(1024)\times 10{,}000{,}000}$	$\frac{(512)}{(2048)\times 8{,}000}=1.56\times10^{-5}$	$\frac{(128)\times 1}{(1024)\times 8{,}000}$
10^{-6}	$\frac{(512)\times 2{,}000}{(2048)\times 100{,}000{,}000}=5\times10^{-6}$	$\frac{(256)\times 2{,}000}{(1024)\times 100{,}000{,}000}$	$\frac{(512)}{(2048)\times 80{,}000}=1.56\times10^{-6}$	$\frac{(128)\times 1}{(1024)\times 80{,}000}$
10^{-7}	$\frac{(512)\times 200}{(2048)\times 100{,}000{,}000}=5\times10^{-7}$	$\frac{(256)\times 200}{(1024)\times 100{,}000{,}000}$	$\frac{(512)}{(2048)\times 800{,}000}=1.56\times10^{-7}$	$\frac{(128)\times 1}{(1024)\times 800{,}000}$
10^{-8}	$\frac{(512)\times 20}{(2048)\times 1{,}000{,}000{,}000}=5\times10^{-8}$	$\frac{(256)\times 20}{(1024)\times 100{,}000{,}000}$	$\frac{(512)}{(2048)\times 8{,}000{,}000}=1.56\times10^{-8}$	$\frac{(128)\times 1}{(1024)\times 8{,}000{,}000}$

5.8 Auto Search

The execution procedures for auto search are explained here.
The auto search of the MP1776A automatically sets the most optimum values for the phase relation between input data and clock, and the data threshold voltage.

These are the items for auto search setup:

- Operation mode setup
  Set either the phase value or the voltage value to acquire its optimum value.
- CH selection
  Select the CH to execute the auto search. The auto search is executed for the selected CHs one by one. When the Independent/Combined Mode is Combined, the auto search is executed for the pair of CHs that are correlated.

Procedure:

1. Press the Auto Search... button on the tool bar of the Main window.
   The Auto Search dialog box is opened.

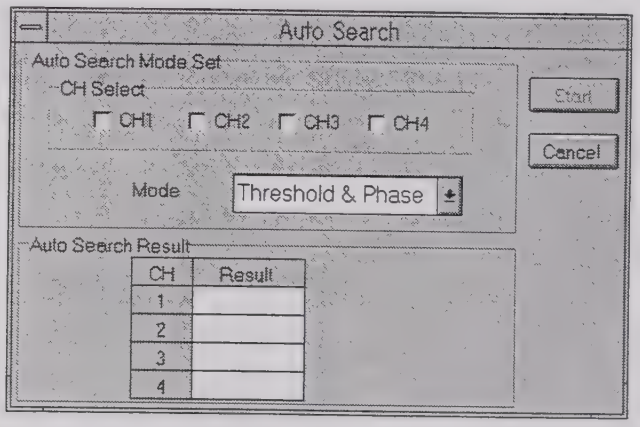


Fig. 5-16 Auto Search dialog box

2. The result is displayed in the Auto Search Result group box when the auto search was executed before the current execution.

Pass	Indicates the previous auto search was successfully completed.
Failed	Indicates the previous auto search failed.
(Blank)	Indicates that the CH was not targeted for execution in the previous auto search.

3. Set the operation mode, as below. Select one from the Mode dropdown list of the Auto Search Mode Set group box.

Threshold & Phase	Acquires the optimum values of both voltage and phase.
Threshold	Acquires the optimum value of voltage
Phase	Acquires the optimum value of phase.
OFF	Does not perform the auto search.

4. Select the channel to perform auto search, as below. Check the check box for CH to execute auto search in the CH Select group box {XE"Auto Search dialog box:Auto Search Mode Set group box:CH Select group box"\y"Auto:Auto Mode:CH Select"}. The setting is switched according to the Independent/Combined Mode.

<Independent>	
CH1, CH2, CH3, CH4	Executes auto search for selected CH.
<2CH Combined>	
CH1, 3, CH2, 4	Executes auto search for the combination of selected CHs.
<4CH Combined>	
CH1-4	Executes auto search of CH1 thru CH4 when they are selected.

Notes:

1. CH where Auto Sync is set to OFF cannot be selected.
2. When the operation mode is Threshold & Phase or Threshold, such CH cannot be selected where the Data input level is set for other than VAR.
3. Press the Start button to start auto search. When the Cancel button is pressed, the Auto Search dialog box is closed and setup here is canceled.

Note:

The Start button cannot be pressed when the auto search is set to OFF.

6. The Auto Searching dialog box is opened when the auto search is started.
   The voltage and the phase values for each CH can be monitored in this dialog box according to the execution progress of auto search.
   Press the Cancel button to finish auto search halfway. The auto search is canceled and the dialog box is closed.

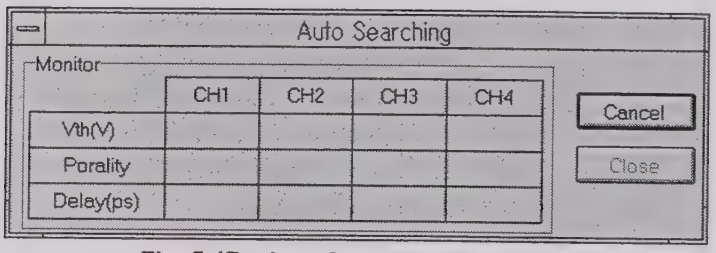


Fig. 5-17 Auto Searching dialog box

7. Press the Close button after auto search completion, to close the dialog box.

Note:

When the reception pattern is PRGM pattern and the edit pattern does not have the 0/1 status change of more than once every 256 bits, there is a possibility of failed completion if auto search is executed in the Threshold & Phase or Phase mode.

5.9 Setting Measurement

5.9.1 Error/alarm measurement function

The following items can be measured by the MP1776A as error/alarm measurement. For details of measurement items, see Appendix C-3 "Details of Error/Alarm Measurement".

Error measurement items

ER EC EI %EFI Threshold EI Threshold %EFI

Error performance (complying with ITU-T G. 821)

ES EFS SES US DM
%US %ES %EFS %SES %DM

Alarm measurement items

- Clock loss interval
- Pattern sync loss interval

■ Error detection mode

The error detection mode can be selected from among the insertion error (INS error), the omission error (OMI error), and the ALL error. The INS error refers to an error in which the input pattern bit is inverted to 1 against the bit 0 of reference pattern. On the contrary, the OMI error is an error in which the input pattern bit is inverted to 0 against the bit 1 of reference pattern. Both errors are detected indiscriminately in the ALL error detection mode.

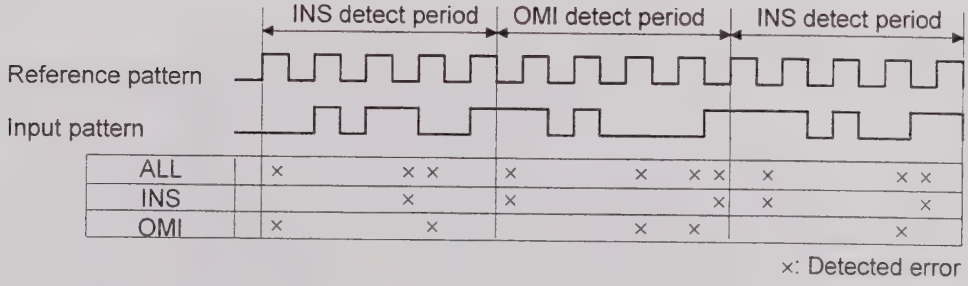


Fig. 5-18 Difference in detected errors depending on error detection mode

■ Relation to Independent/Combined Modes

These are the differences in the error/alarm monitoring method of the MP1776A according to the Independent/Combined Modes:

For Independent: Error/alarm are monitored and calculated for every CH.

For Combined: Monitoring and calculation are performed as the Total value of entire CHs that correlate, in addition to the monitoring and calculation of every CHs. However, the monitoring and calculation of every CH is not performed but only the monitoring and calculation in total are performed, depending on the measurement item (see Table 5-2).

Table 5-2 Relation between Independent/Combined Modes and measurement item

Measurement item	Item details	Independent	Combined	
		Every CH	Total	Every CH
Error measurement	ER, EC	○	○	○
	EI, %EFI	○	○	–
Error interval measurement	Threshold EI Threshold %EFI	○	○	–
Error performance measurement	EC, ES, EFS, SES, US, DM, %US, %ES, %EFS, %SES, %DM	○	○	–
Alarm measurement	Clock Loss interval Sync Loss interval	○	○	–
Frequency measurement		○	○	–

○: Measured

–: Not measured

Table 5-3 Relation between Independent/Combined Modes and monitor measurement item

Monitor item	Independent	2CH Combined			4CH Combined		
	Every CH	Total	CH1, 2	CH3, 4	Total	CH1	CH2, 3, 4
Clock Loss	○	○	○		○	○	
Sync Loss	○	○	–		○	–	
Error	○	○	○		○	○	

○: Monitored

–: Not monitored

5.9.2 Measurement setup

Setup procedures related to the measurement are explained here.
These are the common setting items and the independent items for each CH in the settings related to the measurement, as follows:

- Common setup
  Measurement mode, measurement period, interval for EI/%EFI, threshold for performance calculation, and process at alarm occurrence
- Independent setup for each CH
  The error detection mode

Procedure:

1. Open the Mainframe: Measurement panel.

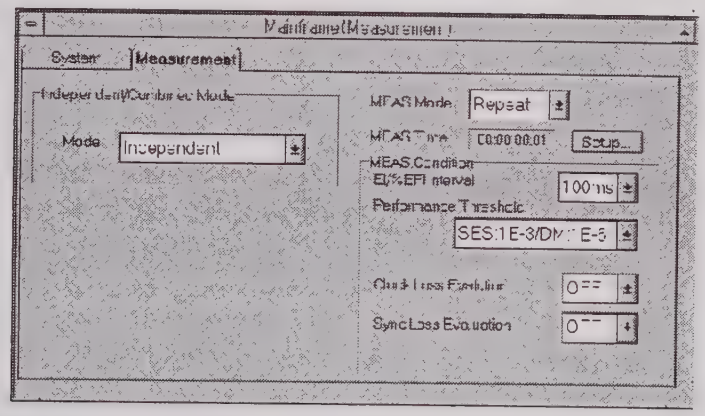


Fig. 5-19 The Mainframe: Measurement panel

2. Set the measurement mode, as below. Select one from the MEAS. Mode dropdown list box. When Untimed is selected, Step 3 below is unnecessary.

Repeat	Repeats measurement in the measurement interval.
Single	Completes measurement in a single measurement interval only.
Untimed	Continues measurement from the measurement start indication to the stop indication.

3. Set the time of 1 measurement period, as below. Press the Setup button to the right of the MEAS.Time. The Measurement Time dialog box is opened. Press the OK button after you input the time of 1 measurement interval to the spin box.

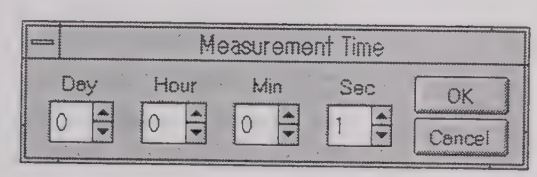


Fig. 5-20 Measurement Time dialog box

4. Set the various measurement conditions, as below. Select one from each drop-down list box in the MEAS Condition group box.

   4.1 Set the interval for EI and %EFI, as below. Select one from the EI/%EFI Interval dropdown list. When one error occurs in the interval section, one EI is counted up.

10 ms	Sets interval at 10 ms.
100 ms	Sets interval at 100 ms.
1 s	Sets interval at 1 s.

   4.2 Set the threshold to calculate SES and DM, as below. Select one from the Performance Threshold dropdown list box.

SES: 1E-3/DM: 1E-6	Uses the 10^{-3} and 10^{-6} thresholds for the SES and DM calculations, respectively.
SES: 1E-4/DM: 1E-8	Uses the 10^{-4} and 10^{-8} thresholds for the SES and DM calculations, respectively.

   4.3 Set the process during the alarm occurrence period, as below. There are alarms for the clock loss and the pattern sync loss. Select the any from among the dropdown list boxes of the Clock Loss Evaluation and the Sync Loss Evaluation, respectively.

ON	The alarm occurrence interval is used for the calculation of the number of intervals for each alarm and the total number of intervals. However, it is not used for the calculation of the number of error intervals. The alarm occurrence interval is the un-available interval. If it is used for the calculation of available time, that is also used for the calculation of the number of error seconds.
OFF	The alarm occurrence interval is used only for the calculation of the number of intervals for each alarm, and not used for the calculation of other items. The alarm occurrence interval is not used for the calculation of both un-availble time and available time. In addition, the intervals under judgement are not used for the calculation of both un-availble time and available time.

   Note:

   Errors counted during alarm occurrences are excluded from the calculation of measurement items, regardless of the above ON/OFF settings.

5. The common setup for all CHs is completed as above. Then, set the error detection mode, as below. The error detection modes are set for each CH. Each CH is set in the sub-window corresponding to it (the CH1, CH2, CH3, and CH4 sub-windows). Since the setting methods and the range are the same for all CHs, an example setup of error detection mode of CH1 is explained here.

6. Open the CH1 sub-window.

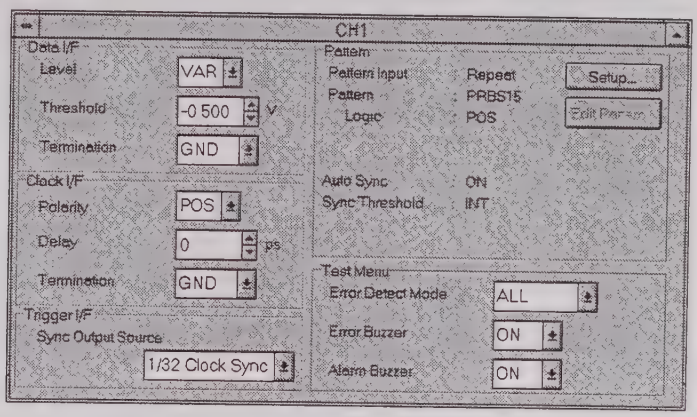


Fig. 5-21 CH1 sub-window

7. Set the error detection mode, as below. Select one from the Error Detect Mode dropdown list of the Test Menu group box.

OFF	Does not detect errors.
ALL	Detects errors, regardless of insertion and omission errors.
INS	Detects the insertion error only.
OMI	Detects the omission error only.

Note:

The above error detection mode setups are as follows, depending on the Independent/Combined Modes:

Independent: Each CH can be independently set.
2CH Combined: The same setup is applied for both the pair of CH1 and CH3 and the pair of CH2 and CH4. The setup change of either CH of the pair is reflected in the other CH.
4CH Combined: The same setup is applied to all CHs. The setup change of any CH is reflected in the other three CHs.

8. This completes the setup. See 5.10 "Setting Buzzer" or 5.9.3 "Starting and stopping measurement" for setting the buzzer or starting the measurement at the next step, respectively.

5.9.3 Starting and stopping measurement

Starting and stopping measurement are executed using the Start button and the Stop button on the tool bar.

Note:

Starting and stopping measurement cannot be executed in the following statuses:

- In Pattern Loading status
- In Delay Busy status

Setups relating to the measured result display are as follows:

- Display mode setup
- Measurement display items setup
- Measurement time display setup

Procedure:

1. Open the Result sub-window, as below. The display of Result sub-window is switched, depending on the Independent/Combined Modes.

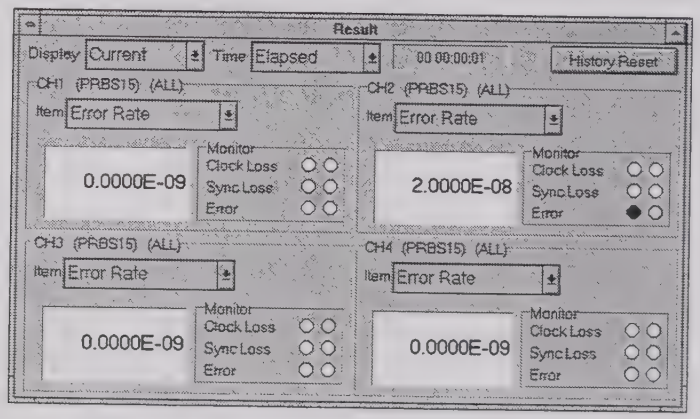


Fig. 5-22 Result sub-window (Independent mode)

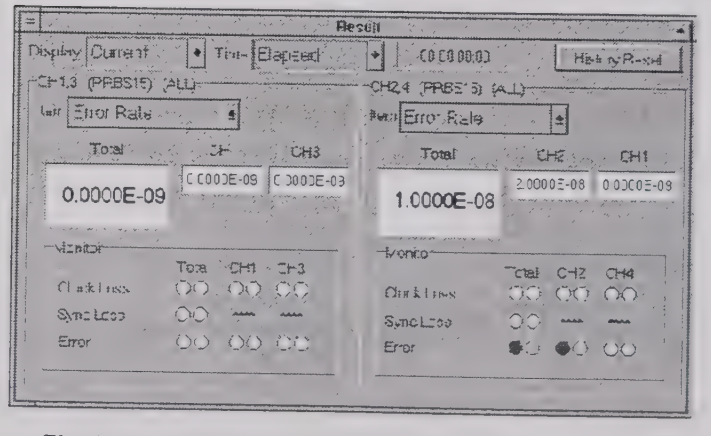


Fig. 5-23 Result sub-window (2CH Combined mode)

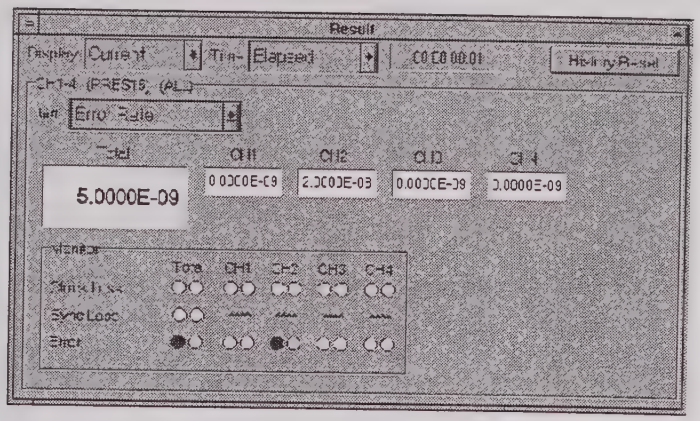


Fig. 5-24 Result sub-window (4CH Combined mode)

Notes:

1. When the Independent/Combined Mode is Combined, both the value for each CH and the value of Total are displayed.

2. There are items that are not measured for every CH in Combined mode (items marked with "-" in Table 5-2 and Table 5-3). "****" is displayed in the display column of every CH if the measurement of every CH is not performed.

3. There are the measurement count value and the monitor display in the measurement result displays. The monitor display monitors the error/alarm occurrence, and indicates the occurrence condition with the software LED.
   Real Time LED and History LED exist in the monitor display. Each operation is as follows:

   - Real Time LED: This is the LED at the left of the software LED. This LED updates the display of error/alarm monitoring condition every 500 ms, regardless of the measurement execution.

   - History LED: This is the LED at the right of the software LED. It updates the display by synchronizing it with the measurement period only during the measurement period. Press the History Reset button of the Result sub-window to reset the display of this LED.

2. Set the display format for the measurement progress, as below. Select one from the Display dropdown list box.

Current	Displays the measured data for the current measurement in real time.
Last	Displays the result of the lastly completed measurement period. The display contents are not updated until the next measurement period is completed.

3. Set error items to be displayed, as below. Select them from the Item dropdown list box.

Error Rate	Displays the error rate.
Error Count	Displays the error count.
EI	Displays the error interval.
%EFI	Displays the error free interval rate.
Pattern Sync Loss	Displays the pattern sync-loss interval.
Clock Loss	Displays the clock loss interval.
Threshold EI	Displays the threshold/error interval.
Threshold %EFI	Displays the threshold/error free interval rate.
Performance	Displays the performance.
Frequency (MHz)	Displays the frequency of input signal. The unit of measured frequency is MHz.

3.1 Select the threshold value when the Threshold EI or the Threshold %EFI selected, as below. The dropdown list for the threshold setup is displayed at the next to the Item dropdown list.

>1.0E-3, >1.0E-4, >1.0E-5, >1.0E-6, >1.0E-7, >1.0E-8, <=1.0E-8

3.2 Select the item when Performance selected, as below. The dropdown list for the performance item setup is displayed at the next to the Item dropdown list.

ES, EFS, SES, DM, US, EC, %ES, %EFS, %SES, %DM, %US

4. Set the time display mode, as below. Select one from the Time dropdown list box.

Elapsed	The elapsed time is displayed. When the MEAS.Mode is Repeat, the elapsed time in the current measurement interval is displayed.
Timed	The rest time for the measurement interval is displayed. When the MEAS.Mode is Repeat, the rest time for current measurement interval is displayed. When the MEAS.Mode is Untimed, it cannot be selected.
Start	The measurement start time is displayed. When the MEAS.Mode is Repeat, the start time for current measurement interval is displayed.
Date & Time	The current date and time are displayed.

5. This completes the setup related to the measured result display.

5.10 Setting Buzzer

The MP1776A has a function to inform the error and alarm occurrence status by using a buzzer.

The setup for Buzzer is as follows:

- System error buzzer setup
  This is set whether the Buzzer sounds or not when a Delay Trouble occurs (Delay Trouble is defined as a system error in the MP1776A).
- ON/OFF setting for error and alarm buzzers
  ON/OFF setting for error and alarm buzzers includes the setting for each CH and the enabling/disabling setting for each CH.

Note:

Since the alarm buzzer has the higher priority than the error buzzer; when an alarm and an error simultaneously occur which are the targets to sound buzzer, the error buzzer does not sound.

Procedure:

1. Open the Mainframe:System panel.

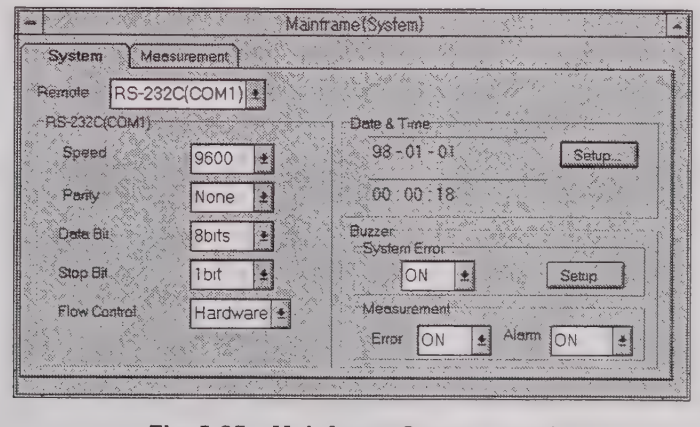


Fig. 5-25 Mainframe:System panel

2. Set the system error buzzer, as below. Set the ON/OFF by using the dropdown list box of the System Error group box.

3. Set the details for system error buzzer when selecting ON in Step 2. Press the Setup... button in the System Error group box. The System Error Buzzer dialog box is opened. Set the CH for the Buzzer to sound when Delay Trouble occurs.

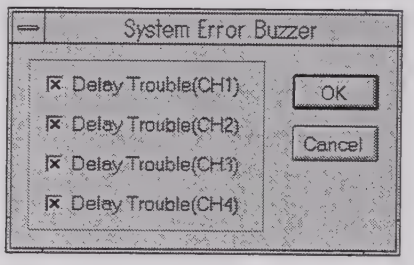


Fig. 5-26 System Error Buzzer dialog box

4. Then, set the ON/OFF of error/alarm buzzer, as below. Set the ON/OFF by using the Error dropdown list box and the Alarm dropdown list box in the Measurement group box.
   When OFF is set here, no error or no alarm buzzer sounds even if the Buzzer for every CH is set to ON.
5. Set the ON/OFF for error/alarm buzzer for each CH, as below. Each CH buzzer is set in the sub-window corresponding to it (the CH1, CH2, CH3, and CH4 sub-windows). Since the setting methods and the range are the same for all CHs, an example setup of CH1 buzzer is explained here.
6. Open the CH1 sub-window.

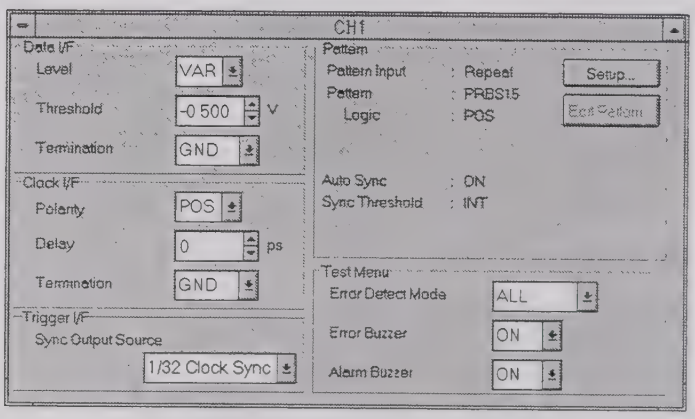


Fig. 5-27 The CH1 sub-window

7. Set the ON/OFF for error/alarm buzzer, as below. Select the ON/OFF by using the Error Buzzer dropdown list box and the Alarm Buzzer dropdown list box in the Test Menu group box.
8. This completes the setup.

5.11 Saving/Opening Set data

5.11.1 Saving set data

Set data can be saved in the floppy disk and the hard disk of the MP1776A. Saving instructions are explained here.

Procedure:

1. Select [File] - [Save] from the Main window menu bar. The Save dialog box is opened.

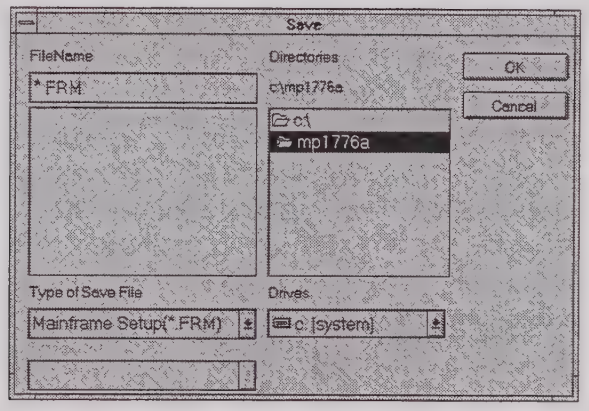


Fig. 5-28 Save dialog box

2. Select the file type to be saved from the Type of Save File dropdown list box.

Mainframe Setup (*.FRM)	Saves the setting items in the Mainframe sub-window.
ED Setup (*.ED)	Saves the setting items in the Data I/F, Clock I/F, Trigger I/F, and Test Menu group boxes of the CH sub-window.
Pattern Data (*.PTN)	Saves the setting items in the Pattern group box of the CH sub-window.

Note:

It is recommended to save edit data in a file for reuse, because the PRGM pattern edit data are initialized when the Independent/Combined Modes are switched.

The Pattern Data in the Independent mode can be saved/opened as the Combined mode data, or the data in the Combined mode as the Independent mode data. However, the setting values of the following items are initialized when the Saved setting value is out of the Opened setting range in the Independent/Combined Modes:

Item \ Mode at Opening	Independent	2CH Combined	4CH Combined
PRGM Pattern Length	2	4	8
PRGM edit pattern	ALL0	ALL0	ALL0
Pattern Sync Mode	Normal	Normal	Normal
Frame Length	8 bits	16 bits	32 bits

3. Set the ED unit to be saved, as below. Saving/Opening the set data are performed in the ED unit (CH). Select the ED unit to be saved in the Source Unit dropdown list box.

ED (Slot1)	Saves the setting of ED unit (CH1) in Slot 1.
ED (Slot2)	Saves the setting of ED unit (CH2) in Slot 2.
ED (Slot3)	Saves the setting of ED unit (CH3) in Slot 3.
ED (Slot4)	Saves the setting of ED unit (CH4) in Slot 4.
ED (Slot1, 3)	Saves the setting of ED unit (CH1, CH3) in Slot 1 and Slot 3.
ED (Slot2, 4)	Saves the setting of ED unit (CH2, CH4) in Slot 2 and Slot 4.
ED (Slot1-4)	Saves the setting of ED unit (CH1 thru CH4) in Slot 1 thru Slot 4.

Notes:

1. This item cannot be selected when the Type of Save File is Mainframe (*FRM).

2. ED (Slot 1, 3) and ED (Slot 2, 4) can be selected only when the Type of Save File is the Pattern Data (*PTN) and the Independent/Combined Mode is 2CH Combined. ED (Slot 1-4) can be selected only when the mode is 4CH Combined.

4. Select the directory and the drive to save the file with the Directories and Drives controls.
5. Input the 8-character or less string file name to be saved, in the File Name text box.
6. This completes the setup. Press the OK button to save data. The file extension is added automatically by the previously selected Type of Save File.

Note:

Though the Drives C and D exist in the hard disk of the MP1776A, the Drive C should be used to save/open files since the Drive D is used for virtual memory.

5.11.2 Open set data

Set data can be opened from the floppy disk and the hard disk of the MP1776A. Opening procedures are explained here.

Procedure:

1. Select [File] - [Open] from the menu bar of the Main window. The Open dialog box is opened.

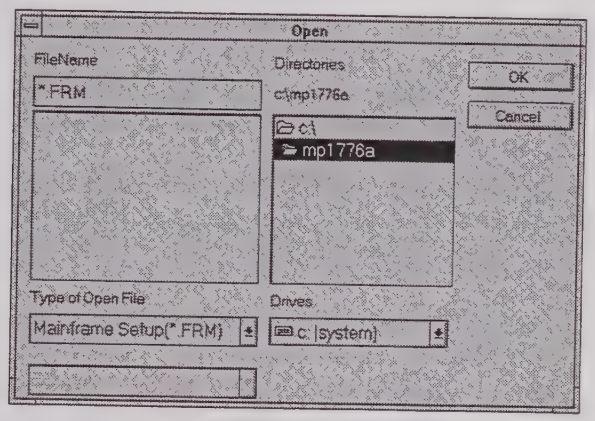


Fig. 5-29 Open dialog box

2. Select the file type to be open from the Type of Open File dropdown list box.

Mainframe Setup (*.FRM)	Opens the file that saves the setting condition in the Mainframe sub-window.
ED Setup (*.ED)	Opens the file that saves the setting condition in the Data I/F, Clock I/F, Trigger I/F, and Test Menu group boxes of the CH sub-window.
Pattern Data (*.PTN)	Opens the file that saves the setting condition in the Pattern group box of the CH sub-window.

Note:

The Pattern Data in the Independent mode can be saved/opened as the Combined mode data, or the data in the Combined mode as the Independent mode data. However, the setting values of the following items are initialized when the Saved setting value is out of the Opened setting range in the Independent/Combined Modes:

Item \ Mode at Opening	Independent	2CH Combined	4CH Combined
PRGM Pattern Length	2	4	8
PRGM edit pattern	ALL0	ALL0	ALL0
Pattern Sync Mode	Normal	Normal	Normal
Frame Length	8 bits	16 bits	32 bits

3. Set the ED unit to be open, as below. Saving/Opening the set data is performed in the ED unit (CH).
Select the ED unit to reflect the opened setting condition in the Destination Unit dropdown list box.

ED (Slot1)	Opens the setting in the ED unit (CH1) of Slot 1.
ED (Slot2)	Opens the setting in the ED unit (CH2) of Slot 2.
ED (Slot3)	Opens the setting in the ED unit (CH3) of Slot 3.
ED (Slot4)	Opens the setting in the ED unit (CH4) of Slot 4.
ED (Slot1, 3)	Opens the setting in the ED units (CH1, CH3) of Slot 1 and Slot 3.
ED (Slot2, 4)	Opens the setting in the ED units (CH2, CH4) of Slot 2 and Slot 4.
ED (Slot1-4)	Opens the setting in the ED units (CH1 thru CH4) of Slot 1 thru Slot 4.

Notes:

1. This item cannot be selected when the Type of Save File is Mainframe (*FRM).

2. ED (Slot 1, Slot 3) and ED (Slot 2, Slot 4) can be selected only when the Type of Save File is the Pattern Data (*PTN) and the Independent/Combined Mode is 2CH Combined. ED (Slot 1 thru Slot 4) can be selected only when the mode is 4CH Combined.

4. Select the directory and the drive to save the file with the Directories and Drives controls.
5. Input the 8-character or less string file name to be saved, in the File Name text box.
6. This completes the setup. Press the OK button to Open data.

Note:

Though the Drives C and D exist in the hard disk of the MP1776A, the Drive C should be used to save/open files since the Drive D is used for virtual memory.

5.11.3 Operating file

The data saved in the floppy disk and the hard disk can be operated by File Manager. File Manager has functions such as file deletion, move, and copy. See Help messages in File Manager for the detailed operations.

Notes:

1. Do not change the file extension, though the file name can be changed by File Manager. If changed, the file may not open.

2. A hard disk may fail due to some causes. Always backup the data saved in the hard disk.

5.12 Outputting Data to Printer

5.12.1 Setting printer

Set the printer before outputting various data to printer.

Procedure:

1. Select [File] - [Printer Setup] from the Main window menu bar. The Printer Setup dialog box is opened.

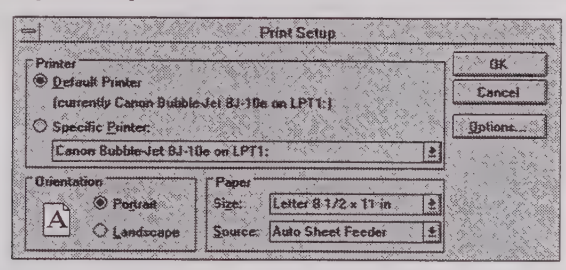


Fig. 5-30 Printer Setup dialog box

2. Set the printer according to the printer connected to the MP1776A.
3. This completes the setup. Press the OK button to enable the setup.

Note:

To connect printer to the MP1776A, see 3.2.2 "Connecting peripheral devices".

5.12.2 Printing data

The MP1776A has a function to output the following information to the printer:

- Measured result
- PRGM pattern
- Hard Copy of display screen

The procedures are explained here to print respective data.

Printing measured result

1. Select [File] - [Print...] from the Main window menu bar. The Print dialog box is opened.

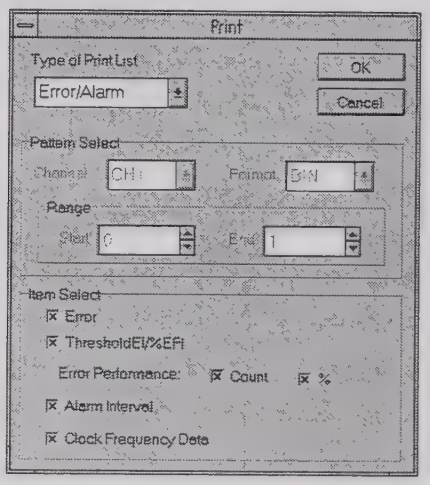


Fig. 5-31 Print dialog box (measured result)

2. Set the data type to output, as below. Select Error/Alarm from the Type of Print List dropdown list box.
3. Select the measurement item to be printed, as below. Check the check box of the item to be printed in the Item Select group box.

Error	Prints ER, EC, EI, and %EFI.
Threshold EI/%EFI	Prints Threshold EI/%EFI.
Error Performance Count	Prints ES, EFS, SES, DM, US, and EC of Error Performance.
Error Performance %	Prints %ES, %EFS, %SES, %DM, and %US of the Error Performance.
Alarm Interval	Prints Alarm Intervals (Clock Loss, Pattern Sync Loss).
Clock Frequency Data	Prints the frequency measured data.

4. This completes the setup. Press the OK button to print the measured result.

Printing PRGM pattern

Procedure:

1. Select [File] - [Print ...] from the Main window menu bar. The Print dialog box is opened.

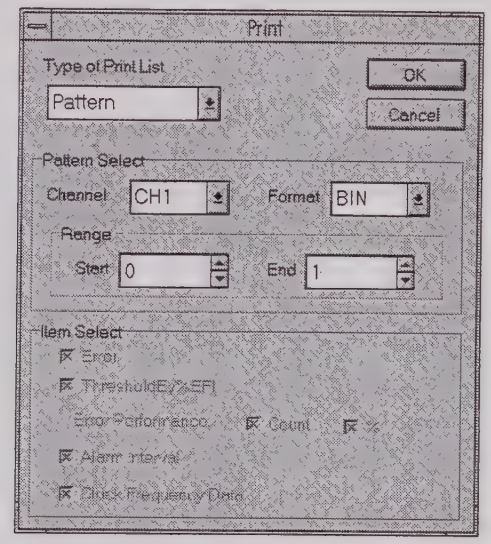


Fig. 5-32 The Print dialog box (printting the PRGM pattern)

2. Set the data type for print, as below. Select Pattern from the Type of Print List dropdown list box.
3. Set the pattern details for print, as below. Setting items are print CH, print format, range for print start and end.

   3.1 Select the CH of PRGM pattern to be printed, as below. Select one from the CH dropdown list box of the Pattern Select group box.

CH1, CH2, CH3, CH4	The PRGM patterns for each CH are printed when the Independent/Combined Mode is Independent.
CH1, 3	The PRGM patterns for CH1 and CH3 are printed when the Independent/Combined Mode is 2CH Combined.
CH2, 4	The PRGM patterns for CH2 and CH4 are printed when the Independent/Combined Mode is 2CH Combined.
CH1-4	The PRGM patterns for CH1 thru CH4 are printed when the Independent/Combined Mode is 4CH Combined.

   3.2 Select the print format, as below. Select one from the Format dropdown list box in the Pattern Select group box.

BIN	Prints in binary format.
HEX	Prints in hexadecimal format.

3.3 Set the start position to print patterns, as below. Set by using the Start spin box in the Range group box.

0 to End Step: 1 * Setting value for Step 3.4.

3.4 Set the end position of pattern to print. Set it by using the End spin box in the Range group box.

Start to Pattern Length-1 Step: 1 * Where, "Pattern Length" is the setting value for pattern length of PRGM pattern. * "Start" is the setting value at para. 3.3 above.

4. This completes the setup. Press the OK button to print the PRGM pattern.

Note:

Only the PRGM pattern can be printed. The PRBS pattern and the Zero-Subst pattern cannot be printed.

Hard Copy of displayed window

Procedure:

1. Open the window to be output to printer.
2. Select [File] - [Hard Copy] from the Main window menu bar. The contents displayed on the window are printed.

Note:

The Printing Message dialog box is opened when data are printed in the method explained above.

The printing is forcibly completed by pressing Cancel button in the Printing Message dialog box.

Fig. 5-33 Printing Message dialog box

5.13 Setting Remote Control

5.13.1 Selecting interface for remote control

RS-232C and GPIB (Option 01) can be used in the MP1776A as the interface for remote control. The setup is explained here to use the interfaces:

Procedure:

1. Open the Mainframe:System panel.

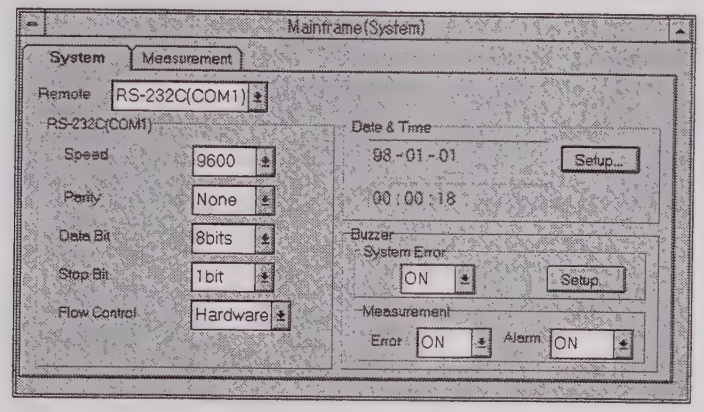


Fig. 5-34 Mainframe:System panel

2. Select the interface to be used by using the Remote dropdown list box.

RS-232C (COM1)	RS-232C is used as the interface for remote control.
GPIB	GPIB is used as the interface for remote control. It can be selected when Option 01 (GPIB option) is installed.
None	No interface for remote control is used.

3. This completes the setup to use a interface. For the detailed settings for each interface, see the following pages:

5.13.2 Setting RS-232C

The setup is explained to use RS-232C as the interface for remote control.

Procedure:

1. When RS-232C (COM1) is selected as the interface, the RS-232C (COM1) group box appears in the Mainframe:System panel. Perform the setup for RS-232C in the RS-232C (COM1) group box.

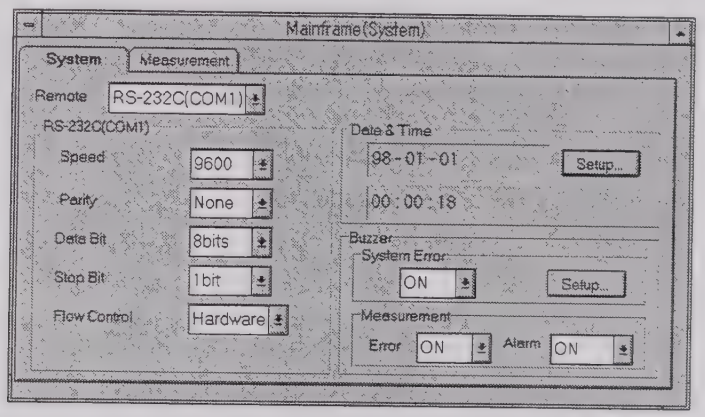


Fig. 5-35 Mainframe:System panel (RS-232C)

2. Set the data transmitting speed, as below. Select the speed to be used from the Speed dropdown list box.

110	Sets the speed at 110 bps.
300	Sets the speed at 300 bps.
600	Sets the speed at 600 bps.
1200	Sets the speed at 1200 bps.
2400	Sets the speed at 2400 bps.
4800	Sets the speed at 4800 bps.
9600	Sets the speed at 9600 bps.
19200	Sets the speed at 19200 bps.

3. Set the parity type, as below. Select one from the Parity dropdown list box.

None	Uses no parity.
Even	Sets the even parity.
Odd	Sets the odd parity.

4. Set the number of bits for transmission character length, as below. Select one from the Data Bit dropdown list box.

8 bits	Set the 8-bit length.
7 bits	Set the 7-bit length.

5. Set the stop bit length, as below. Select one from the Stop Bit dropdown list box.

2 bits	Set the 2-bit length.
1 bit	Set the 1-bit length.

6. Set the flow control method, as below. Select one from the Flow Control dropdown list box.

Xon/Xoff	Performs the flow control using the Xon/Xoff characters in addition to the control line.
Hardware	Performs the flow control using the control line of RS-232C.
None	Performs no flow control.

7. This completes the RS-232C setup.

5.13.3 Setting GPIB

The setup procedure is explained to use GPIB interface for remote control.

Procedure:

1. When GPIB is selected as the interface, the GPIB group box appears in the Mainframe:System panel. Perform the setup for GPIB in the GPIB group box.

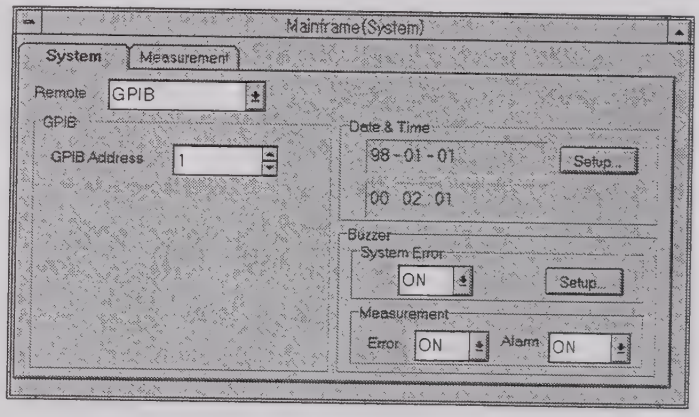


Fig. 5-36 Mainframe:System panel (GPIB)

2. Set the GPIB address for the MP1776A, as below. Specify the appropriate address in the GPIB Address spin box.

From 0 to 30 / Step: 1

3. This completes the setup.

5.14 Setting Date/Time

The procedures are explained to set date and time for the MP1776A.

Procedure:

1. Open the Mainframe:System panel.

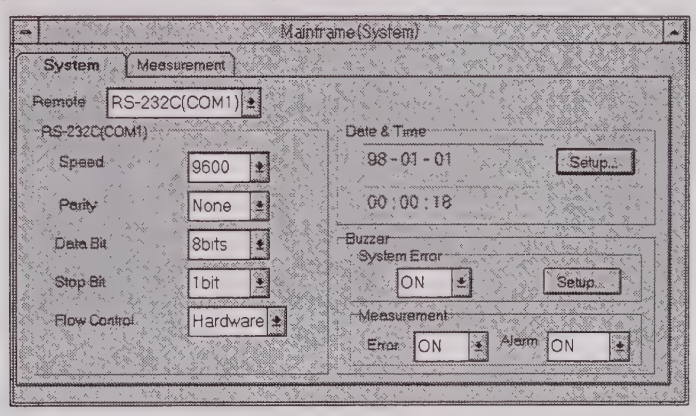


Fig. 5-37 Mainframe:System panel

2. Press the Setup button in the Date & Time group box. The Date & Time Setting dialog box is opened.

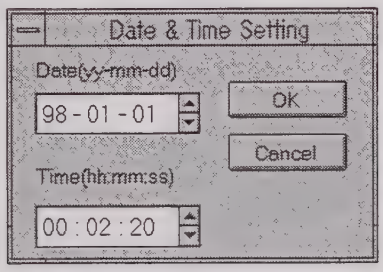


Fig. 5-38 Date & Time dialog box

3. Set the date, as below. Input the date to the Date spin box. The display order for date is Year-Month-Day.

0 to 99/Step: 1	Set the lower 2 digits for year from 1996 thru 2095.
1 to 12/Step: 1	Set 2 digits for month from among January thru December.
1 to 31/Step: 1	Set 2 digits for day from among 1st thru 31st.

4. Set the time, as below. Set by using the Time spin box. The display order for time is Hour-Minute-Second.

0 to 23/Step: 1	Set 2 digits for hour from among 0 thru 23 hours.
1 to 59/Step: 1	Set 2 digits for minutes from among 0 thru 59 minutes.
1 to 59/Step: 1	Set 2 digits for seconds from among 0 thru 59 seconds.

5. This completes the setup. Press the OK button to enable the setup.

Note:

The MP1776A is equipped with an IC to control the reference time, and the process is operated to enable the time data held by the IC in the application and other hardware when the MP1776A is started.

Date and time can be set by using the Windows® function even when the application for the MP1776A control is not started. However, the set date and time are not set to the IC for the time control of the MP1776A. Therefore there are two time data, one changed by Windows® and the other held by the IC for time control in the MP1776A.

When the MP1776A is started in the above status, the time data held by the IC becomes effective as mentioned above, and the date/time changed by Windows® return to the status (date/time held by the IC) before the change.

Change the date and time by using the Mainframe:System panel of the MP1776A application to avoid the above situation.

5.15 Initializing Settings

The setting conditions, the measured results, etc. in the MP1776A can be initialized, and returned to the factory shipment conditions, as described below.

Procedure:

1. Select [File] - [Initialize] from the Main window menu bar.
2. This initializes all the settings to the factory shipment status. A warning message appears to confirm the execution/cancellation of the initialization before initializing the settings.

Note:

This function initializes the setting conditions and display contents, but does not initialize the settings related to remote control.

For the factory shipment condition for each setting, see Appendix A "Setting Item List For Each Window".

5.16 Operating MP1776A Menu

The menu program for MP1776A is started when the application of the MP1776A is completed and Windows® is completed.
Items that can be executed from the menu screen are as follows:

1. Start Windows
2. Defrag
3. Scandisk
4. Windows Setup
5. MP1776A Startup with Default Settings

Each item is explained here.

Start Windows

The MP1776A application is started after Windows® is started when 1 is selected at the menu screen Select Number.

Defrag

When 2 is selected at the menu screen Select Number, the Defrag command of MS-DOS® is started.

The Defrag command relocates files that are stored out of order on the hard disk, and reduces the file access time. Execute the Defrag program according to the instruction on the screen.

Reference:

Repeated reading and writing on the hard disk gradually fragments the information on the hard disk. Contents do not differ between the fragmented case and the defragmented case on the hard disk. However, the fragmented information requires extra access time. Defragmented information can reduce the access time.

Scandisk

When 3 is selected at the menu screen Select Number, the Scandisk command of MS-DOS® is started.

The Scandisk command repairs the problematic places by analyzing the disk status. Execute the Scandisk program according to the instructions on the screen.

Reference:

The free disk space will be occupied by damaged disk area if it is left as is while using the disk. In addition, applications may not operate normally and the created data may be lost. The Scandisk command can repair the damaged disk area by analyzing disk status.

Windows Setup

When 4 is selected at the menu screen Select Number, the Windows Setup program of the MS-DOS® version is started.

The Windows Setup program displays the information on hardware and software currently installed. In addition, it automatically detects newly installed hardware and software, and performs setup operation so that they can be used on Windows®.

Execute this program to setup display, keyboard, and mouse. (The Windows Setup program of Windows® version can be executed on the Main group of Windows®.) The functions of both programs are the same except for operation differences).

- Front panel key correspondence to keyboard keys
  There are no function keys or ESC key on the front panel of the MP1776A, although they are used in the Windows Setup program to change/save settings. Therefore, keys on the front panel correspond to keyboard keys to change/save settings even when the external keyboard is not connected to the MP1776A.

Key on keyboard	Key on front panel
F1 key	m/k key
F3 key	n/M key
F10 key	p/G key
ESC key	Remote key

Note:

Do not change the settings with the Windows Setup program except when a peripheral device is connected and the setting change is necessary. See Section 3 for connecting peripheral devices.

MP1776A Startup with Default Settings

When 5 is selected at the menu screen Select Number, the MP1776A application is started after Windows® is started. The application is started with the factory shipment condition in this case.

Section 6 Measurement Example

6.1 1:4 DEMUX IC Test 6-2
6.2 Burst Measurement 6-4

6.1 1:4 DEMUX IC Test

Evaluation example of 1:4 DEMUX IC is explained here in combination with the MP1758A Pulse Pattern Generator (PPG), as shown in Fig. 6-1.

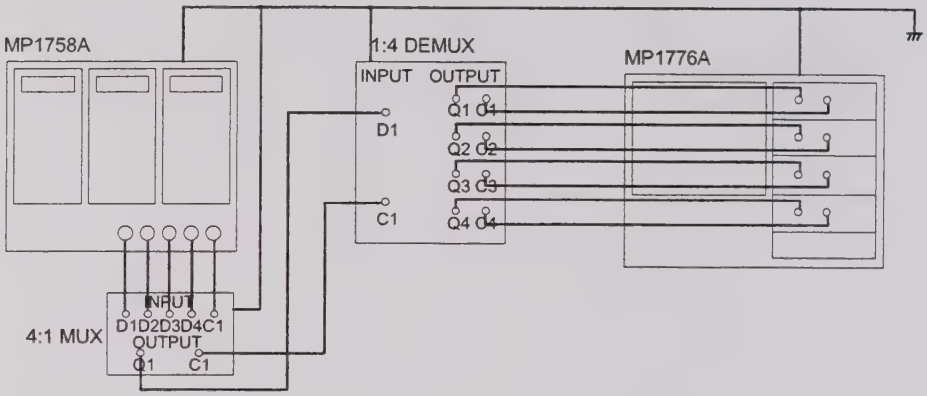


Fig. 6-1 Evaluation example of 1:4 DEMUX IC.

(1) Setup

[1] Connect the measuring instrument Ground with the device under test (DUT) Ground, and then connect those Grounds to earth.

[2] Connect each the power cord to power source.

[3] Connect the input and output signals by using the attached coaxial cables or the equivalent coaxial cables. At that time, use the cables after short-circuiting the inner and outer conductors with tweezers, etc. for countermeasure against electrostatic charge.

(2) Setting measurement condition

[1] Initialize the MP1758A and MP1776A, as below.
Turn ON the power while pressing the LOCAL key, for MP1758A to initialize the setting.
Select Initialize on the File menu in Main window, for MP1776A to turn the setting into the initial status.
See Appendix A for initial setting contents of the MP1776A.

[2] Set the sub-window to Mainframe, the panel to Measurement, and the Independent/Combined Modes to 4CH Combined.

[3] Turn ON the device under test (DUT) power.

[4] Set the MP1758A frequency at any value.

[5] Set the MP1776A to the DUT termination condition.

[6] Set the termination condition by using the Data I/F of the sub-window CH.

[7] Then press the Auto Search key.

[8] Open the Auto Search dialog box, select all CH1 thru CH4 by using the CH Select, and press the Start button for execution.

[9] After completing the Auto Search, confirm that the error and alarm lamps for each CH are turned OFF.
Change the input Clock phase to DUT or the input Data offset, if an error lamp is turned ON.

[10] Press the Start button in this status to start the measurement.

[11] Change the input Clock phase to DUT or the input data offset, when measuring the DUT margin.

6.2 Burst Measurement

Burst measurement example is explained here in combination with the MP1758A Pulse Pattern Generator (PPG), as shown in Fig. 6-2.

The burst measurement is the function to perform the assumed measurement such as optical circuiting loop test, as shown in Fig. 6-2.

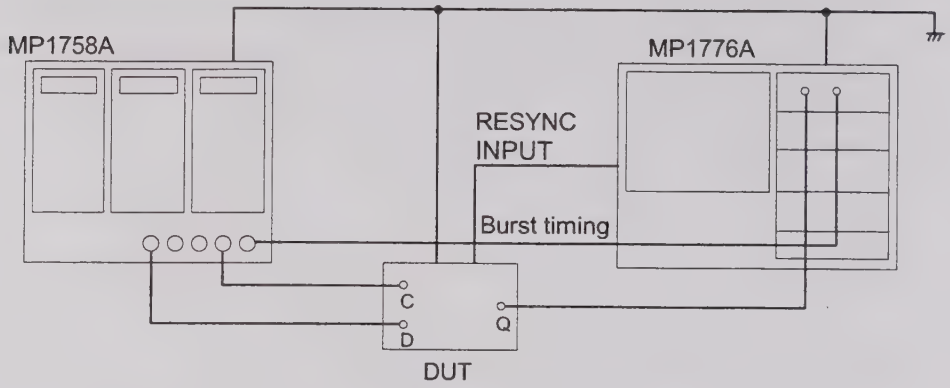


Fig. 6-2 Burst measurement example

(1) Setup

[1] Connect the measuring instrument Ground with the device under test (DUT) Ground, and then connect those Grounds to earth.

[2] Connect each the power cord to power source.

[3] Connect the input and output signals by using the attached coaxial cables or the equivalent coaxial cables. At that time, use the cables after short-circuiting the inner and outer conductors with tweezers, etc. for countermeasure against electrostatic charge.

(2) Setting measurement condition

[1] Initialize and start the MP1758A and MP1776A, as below.
Turn ON the power while pressing the LOCAL key, for MP1758A to initialize the setting.
Select Initialize on the File menu in Main window, for MP1776A to turn the setting into the initial status.
See Appendix A for initial setting contents of the MP1776A.

[2] Set the sub-window to Mainframe, the panel to Measurement, and the Independent/Combined Modes to Independent.

[3] Set the sub-window to CH1, and then the Pattern Input to Burst.

[4] Turn ON the device under test (DUT) power.

[5] Make the input/output timing to the MP1776A, as shown in Fig. 6-3. The effective error measurement range is also shown in Fig. 6-3.

[6] Change and adjust the Delay of burst timing signal so that errors decrease at the MP1776A.

[7] Press the Start button to start the measurement, in this status.

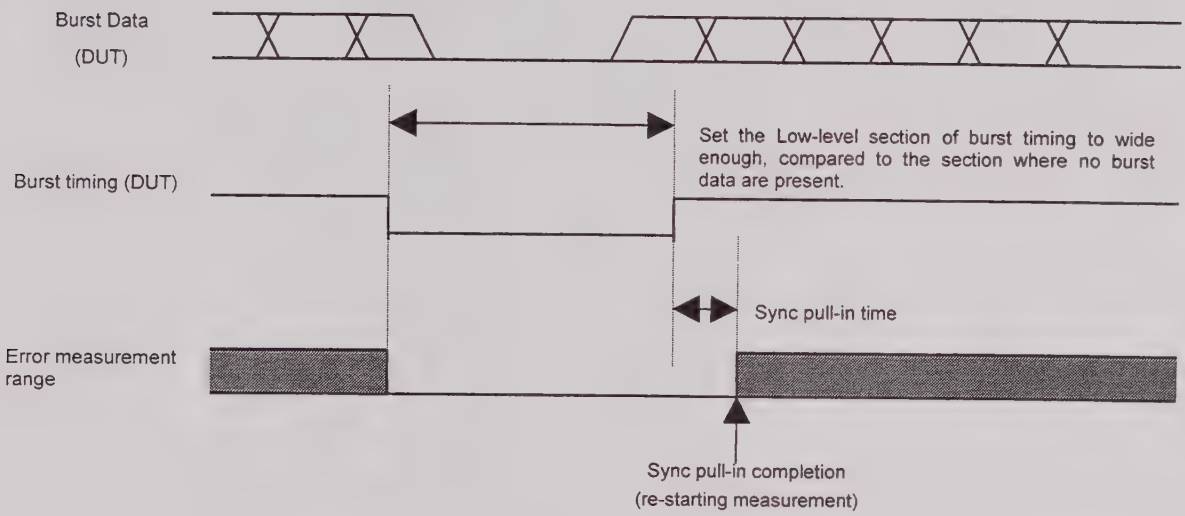

Burst Data
(DUT)
Burst timing (DUT)
Set the Low-level section of burst timing to wide enough, compared to the section where no burst data are present.
Sync pull-in time
Error measurement range
Sync pull-in completion
(re-starting measurement)

Fig. 6-3 Burst measurement timing

The measurement is re-started after the sync pull-in completion when the burst timing is completed. Therefore, the measurement prohibition time is equal to the (low-level burst timing section + sync pull-in time).

Note:

These are the restrictions at the time of burst measurement:

- The accuracy of frequency measurement is not assured at the time of burst measurement (when the Clock input to the MP1776A is the burst).
- The accuracy of Auto Search function is not assured.

Section 7 Performance Test

7.1 Requirement for Performance Test 7-2
7.2 Instruments required for Performance Test 7-2
7.3 Performance Test 7-3
7.3.1 Operation frequency 7-3
7.3.2 Input data level 7-5
7.3.3 Input clock level 7-6
7.3.4 Pattern 7-7
7.3.5 Measurement items 7-8

7.1 Requirement for Performance Test

Conduct the performance test to confirm the main performance of the MP1776A satisfies the specifications. Carry out this test upon acceptance inspection of this instrument, at operation check after repairing, and at periodical test (every six months).

Performance test items are shown below.

- Operation frequency
- Input data level
- Input clock level
- Pattern
- Measurement item

7.2 Instruments required for Performance Test

Instruments required for performance test are shown in Table 7-1.

Table 7-1 Instruments required for Performance Test

Instrument name (Anritsu)	Required performance	Measurement item
Pulse pattern generator (MP1758A)	Operation frequency: 100 MHz to 12.5 GHz Other performance: The same as MP1758A	• Operation frequency • Input level • Pattern • Measurement item
Sampling oscilloscope	Band: 50 GHz or more	

7.3 Performance Test

Warm up the MP1776A and each measuring instrument for 30 minutes or more before starting the performance test.

Connection and procedures to use the MP1758A as the pulse pattern generator are shown below.

7.3.1 Operation frequency

(1) Specifications

100 MHz to 12.5 GHz

(2) Connection

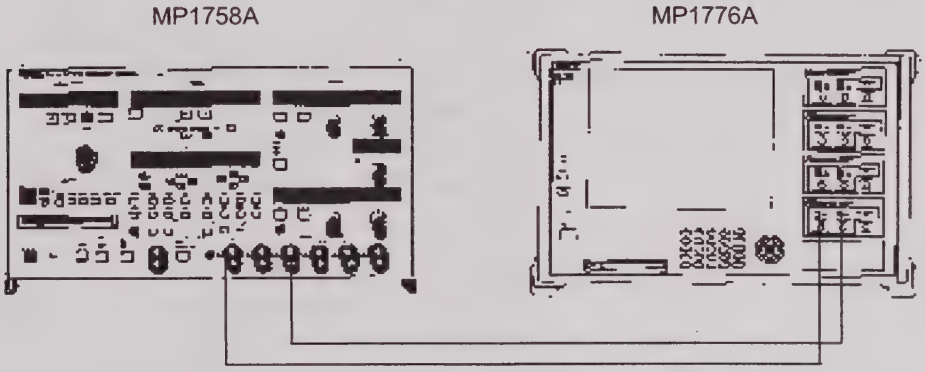


Fig. 7-1 Connection between MP1776A and MP1758A

(3) Procedures

Independent Mode

[1] Make connections as shown in Fig. 7-1.

[2] Initialize the MP1776A and MP1758A, after all of the input/output are removed except for power supply.

Initialize the MP1776A settings by selecting Initialize on the File menu in Main window.

Turn ON the POWER switch while pressing LOCAL key, for MP1758A to initialize the MP1758A settings.

See Appendix A for the initial setting contents for the MP1776A.

Set the sub-screen to Mainframe, the panel to Measurement, and the Independent/Combined Modes to Independent.

[3] Set the MP1758A frequency at any value.

[4] Then, press the Auto Search key.

Open the Auto Search dialog box, select the input CH by the CH Select, and press the Start button for execution of Auto Search.

[5] Check that the ERRORS lamp of the MP1776A is not turned ON, after Auto Search completion.

[6] Check whether the MP1776A operates normally, while repeating Steps [3] thru [6].

[7] Change the connection channels, and execute Steps [3] thru [6], when multiple ED units of MP1776A are installed.

Combined Mode

[1] Make connections as shown in Fig. 7-1.

[2] Initialize the MP1776A and MP1758A, after all of the input/output are removed except for power supply.
Initialize the MP1776A settings by selecting Initialize on the File menu of Main window.
Turn ON the POWER switch while pressing the LOCAL key of the MP1758A to initialize the MP1758A settings.
See Appendix A for the initial setting contents of the MP1776A.
Set the sub-screen to Mainframe, the panel to Measurement, and the Independent/Combined Modes to 4CH Combined.

[3] Set the MP1758A frequency at any value.

[4] Then, press the Auto Search key.
Open the Auto Search dialog box, select all of CH1 thru CH4 by the CH Select, and press the Start button for execution of Auto Search.

[5] Check that the ERRORS lamp of the MP1776A is not turned ON, after the Auto Search completion.

[6] Check that the MP1776A operates normally, after repeating Steps [3] thru [6].

7.3.2 Input data level

(1) Specifications

Amplitude : 0.5 to 2 Vp-p

Offset : –2 to +2 V

Threshold voltage (V_{TH}) : –3 to +1.75 V

(2) Connection

Connection forms are the same as 7.3.1 (2), as shown in Fig. 7-1.

(3) Procedures

[1] Initialize the MP1776A and MP1758A after all of the input/output are removed except for power supply.
Initialize the MP1776A settings by selecting Initialize on the File menu in Main window.
Turn ON the POWER switch while pressing LOCAL key of the MP1758A to initialize the MP1758A settings.
See Appendix A for the initial setting contents of the MP1776A.

[2] Make connections, as shown in Fig. 7-1.

[3] Set the MP1776A and MP1758A as shown in the table below, execute the MP1776A Auto Search, and then check that the ERRORS lamp is not turned ON.

Note:

The THRESHOLD values for the MP1776A in the table below are theoretical ones.
Therefore, perform the measurement after adjusting the THRESHOLD values of the MP1776A to correct ones by measuring the data output level of the MP1758A with a calibrated sampling oscilloscope in advance.

Item / Setting order	MP1758A DATA		MP1776A DATA	
	AMPLITUDE	OFFSET (V_{OH})	TERM	THRESHOLD
[1]	2.000 Vp-p	–2.000 V	GND	–3.000 V
[2]	0.50 Vp-p	–2.000 V	GND	–2.25 V
[3]	2.000 Vp-p	2.000 V	GND	1.000 V
[4]	0.50 Vp-p	2.000 V	GND	1.75 V
[5]	0.800 Vp-p	–0.900 V	–2 V	–1.300 V

7.3.3 Input clock level

(1) Specifications

Amplitude : 0.5 to 2 Vp-p

Offset (V_{OH}) : –2 to +2 V

(2) Connection

Connection forms are the same as 7.3.1 (2), as shown in Fig. 7-1.

(3) Procedures

[1] Initialize the MP1776A and MP1758A, after all of the input/output are removed except for power supply.
Initialize the MP1776A settings by selecting Initialize on the File menu of Main window.
Turn ON the POWER switch while pressing LOCAL key of the MP1758A to initialize the MP1758A settings.
See Appendix A for the initial setting contents of the MP1776A.

[2] Make connections as shown in Fig. 7-1.

[3] Set the MP1776A and MP1758A as the following table below, execute the MP1776A Auto Search, and then check that the ERRORS lamp is not turned ON:

Item / Setting order	MP1758A CLOCK		MP1776A CLOCK TERM
	AMPLITUDE	OFFSET(V_{OH})	
[1]	2.000 Vp-p	–2.000 V	GND
[2]	0.50 Vp-p	–2.000 V	GND
[3]	2.000 Vp-p	2.000 V	GND
[4]	0.50 Vp-p	2.000 V	GND
[5]	0.800 Vp-p	–0.900 V	–2 V

7.3.4 Pattern

(1) Specifications

Pseudo random (PRBS) pattern

Generation polynomial: PRBS 2^7-1, 2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{20}-1$, $2^{23}-1$, $2^{31}-1$

(2) Connection

Connection forms are the same as 7.3.1 (2), as shown in Fig. 7-1.

(3) Procedures

[1] Initialize the MP1776A and MP1758A, after all of the input/output are removed except for power supply.

Initialize the MP1776A settings by selecting Initialize on the File menu in Main window.

Turn ON the POWER switch while pressing LOCAL key of the MP1758A to initialize the settings.

See Appendix A for the initial setting contents of the MP1776A.

[2] Make connections as shown in Fig. 7-1.

[3] Check that the ERRORS lamp is not turned ON, while changing the pattern mode of the MP1776A and MP1758A from PRBS 2^7-1, PRBS 2^9-1, PRBS $2^{11}-1$, PRBS $2^{15}-1$, PRBS $2^{20}-1$, PRBS $2^{23}-1$, and then on to PRBS $2^{31}-1$.

7.3.5 Measurement items

(1) Specifications

Error rate: 0.0000×10^{-16} to 1.0000×10^{-0}
Number of errors: 0 to 9.9999×10^{16}
Error interval (EI): 0 to 9999999
Error free interval (EFI): 0.0000 to 100.0000%
Clock frequency: 100 MHz to 12.5 GHz
Accuracy: ±(10 ppm+1 kHz)

(2) Connection

The connection form is the same as 7.3.1 (2), and is shown in Fig. 7-1.

(3) Procedures

[1] Set the MP1758A frequency at 10 GHz, after initializing the MP1776A and MP1758A when all of the input/output are removed except for power supply.
Initialize the MP1776A settings by selecting Initialize on the File menu in Main window.
Turn ON the POWER switch while pressing LOCAL key of the MP1758A to initialize the MP1758A settings.
See Appendix A for the initial setting contents for the MP1776A.

[2] Make connections as shown in Fig. 7-1.

[3] Check whether the ERRORS lamp is not turned ON when executing the MP1776A Auto Search.

[4] Turn ON the error insertion function of the MP1758A (Error insertion: Single).

[5] Set the MP1776A measurement mode to SINGLE and the measurement time at 10 seconds.

[6] Press the ERROR ADDITION SINGLE key of the MP1758A once, after starting the measurement by clicking the Start button of the MP1776A.

[7] Check that the values displayed on the Result window of the MP1776A are as follows, after completing the measurement (10 seconds later):
Error rate: 1.0000E–11
Number of errors: 1
Error interval (EI): 1
Error free interval (EFI): 90.0000%
Clock frequency: 9999.899 to 10000.101 MHz

Section 8 Maintenance

8.1 Daily Service 8-2
8.2 Precautions for Storage 8-2
8.3 Transportation 8-3
8.4 Calibration 8-3

8.1 Daily Service

- Wipe out dirt by using a cloth soaked with thinned neutral detergent.
- Suck off dust with the vacuum cleaner.
- Fasten loose installation parts, such as screws, with specified tools.

8.2 Precautions for Storage

Be aware of the following matters for long time storage:

1. Store this instrument after removing dust and dirt.
2. Avoid storage in places where this instrument is subject to a temperature of 60 centigrade or more, –20 centigrade or less, or humidity of 85% or more.
3. Avoid storage in places subject to direct sunlight or dust.
4. Avoid storage in places subject to condensation or an activated gas corrosion.
5. Avoid storage in places where this instrument may be oxidized or exposed to extreme vibration.

- Recommended storage conditions

To satisfy the above precautions for long-term storage, store this instrument in the following environment:

1. Temperature: from 5 centigrade to 30 centigrade
2. Humidity: From 40 to 75%
3. Small daily changes in temperature and humidity

8.3 Transportation

To transport this instrument, use the packing materials if they are kept after unpacking. If they are not kept, pack it according to the procedure shown below. Handle this equipment while wearing clean gloves in order not to scratch or dent it.

1. Clean dirt and dust on this instrument by using a dried cloth.
2. Check whether there are loose or lost screws.
3. Protection projecting or easily misshapen parts and wrap this instrument in a polyethylene sheet. In addition, wrap in moisture-proof paper, etc.
4. Put the wrapped instrument in the cardboard box and close openings with adhesive tape. Store them in a wooden box, etc. depending on the transportation distance and means as required.
5. Put this instrument in an environment satisfying conditions for 8.2 "Precautions for Storage" during the transportation.

8.4 Calibration

This instrument cannot be calibrated except by the manufacturer. Every year calibration is recommended to assure performance.

Section 9 Disposal

This instrument uses some built-in compound semiconductors containing arsenic and a lithium battery. Be careful to comply with regulations for each country and each district when disposing.

Appendix A Initial Setting List

Settings for this instrument at factory shipment are shown in the following table:

Table A-1 Initial settings list (1/2)

Panel	Group box	Setting item	Initial value
Mainframe: System		Remote	RS-232C (COM1)
	RS-232C (COM1)	Speed	9600
		Parity	None
		Data Bit Length	8 bits
		Stop Bit Length	1 bit
		Flow Control	Xon/Xoff
	GPIB	GPIB Address	1
	Buzzer: System Error		ON
	Buzzer: Measurement	Error	ON
		Alarm	ON
Mainframe: Measurement	Independent/Combined Mode	Mode	Independent
	—	MEAS. Mode	Repeat
		MEAS. Time	00:00:00:01
	MEAS. Condition	EI/%EFI Interval	100 ms
		Performance Threshold	SES: 1E-3/DM:1E-6
		Clock Loss Evaluation	OFF
		Sync Loss Evaluation	OFF
CH1 sub-window Same for CH2, CH3, and CH4 sub-windows	Data I/F	Level	VAR
		Threshold	–0.500
		Termination	GND
	Clock I/F	Polarity	POS
		Delay	0
		Termination	GND
	Trigger I/F	Sync Output Source	1/32 Clock Sync
	Pattern	Pattern Input	Repeat
		Pattern	PRBS15
		Logic	POS
	(When PRGM is selected for the Pattern)	Pattern	Zero-Subst
		Pattern Length	2^7
		Zero-Length	127
		Logic	POS

Table A-1 Initial settings list (2/2)

Panel	Group box	Setting item	Initial value
CH1 sub-window Same for CH2, CH3, and CH4 sub-windows	(When PRGM is selected for the Pattern)	Pattern	PRGM
		Pattern Length	2 (For Independent) 4 (For 2CH Combined) 8 (For 4CH Combined)
		Logic	POS
		Auto Sync	ON
		Sync Threshold	INT
		Pattern Sync Mode	Normal
		Frame Length	8 bits (For Independent) 16 bits (For 2CH Combined) 32 bits (For 4CH Combined)
	Test Menu	Error Detect Mode	ALL
		Error Buzzer	ON
		Alarm Buzzer	ON
Result	—	Display	Current
		Time	Elapsed
		Item	Error Rate

Appendix B Troubleshooting

Microsoft® MS-DOS® operating system and Microsoft® Windows® operating system are installed in this instrument. Applications can be executed and the Windows® setting can be changed in the same way as Windows® used in the computer.

Troubles assumed to be caused by the Windows® setting change and the restoration are explained here.

■ Touch panel does not operate

The touch panel stops operating when the mouse driver setting is changed by the Windows Setup program.

Set the mouse setting to TTwin v3.20: AR5000 and Digitouch in the Windows Setup program and re-start Windows®. The touch panel returns to a usable status after re-start.

■ The front panel LCD display goes OFF

The front panel LCD display goes OFF when Chips CPL is selected from the Control Panel for Windows®, the Display Driver Control Panel program is started, and the CRT is selected in the Display group box setting.

Set the Display group box setting to Both by watching the external display when it is connected and used. The LCD display is restored. When the external display is not connected, turn OFF the power after confirming the access lamp for the hard drive is not turned ON. The LCD display is stored after turning ON the power.

■ The external display goes OFF

The external display goes OFF when Chips CPL is selected from the Control Panel for Windows®, the Display Driver Control Panel program is started, and then LCD is selected in the Display group box setting.

Set the Display group box setting to Both by watching the front panel LCD. The external display is stored.

■ Application characters are not displayed normally

Applications characters are not normally displayed when the Fonts program for the Control Panel for Windows® is used to delete a character Font used by this instrument.

Reinstall the deleted font by using the Fonts program.

■ Message urges insertion of the Windows® disk

When setting the printer, etc. in the Control Panel for Windows®, a message such as "Insert Microsoft Windows 3.1 Disk#5 ..." may be displayed. In this case, insert the attached recovery disk into the floppy disk drive of this instrument. However, the corresponding numbers between the recovery disk to be inserted and the disk displayed in the message are shown in the following table:

Disk number displayed in the message	1	2		5	6
Corresponding recovery disk number	5	6		9	10

Appendix C Explanation of Terms and Operations

C.1 Transmission and Reception Patterns C-2
C.2 Printer Output Format..... C-4
C.3 Error/Alarm Measurement Details..... C-6
C.4 Basic Terms for Windows®..... C-10

C.1 Transmission and Reception Patterns

Pattern-types that can be received by MP1776A can be selected from the following patterns and set:

(1) PRGM pattern (programmable pattern)

(2) PRBS pattern (pseudo random pattern)

(3) Zero-Subst pattern (zero substitution pattern).

What is the PRGM pattern?

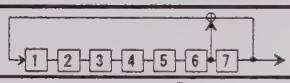
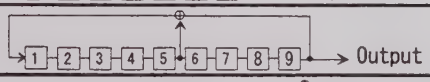
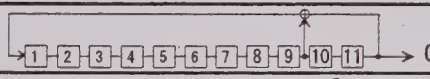
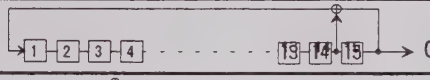
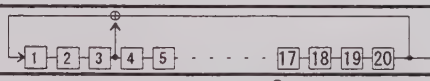
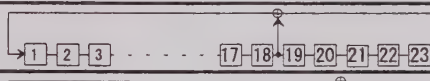
It is a pattern the user can set at random. The reception pattern can be edited by using the Pattern Editor dialog box for the channels set for PRGM.

What is the PRBS (Pseudo Random Binary Sequence) pattern?

This pattern is generated in the principle shown in Table C-1. The same bit array does not exist in a single period of PRBS pattern that has the 2^N-1 period when selecting any continuous N bits in the bit array. The pattern namely possesses all bit arrays other than '0' that can be considered in a single period. Therefore, the use of PRBS for the test signal provides the test in the status close to actual signals on transmission paths.

The output level for the PRBS pattern is that the logic value "1" corresponds to the Low level and the logic value "0" corresponds to the High level (negative logic).

Table C-1 Pseudo random pattern generation principle

Period	Generation formula	Block diagram
2^7-1	$1+X^6+X^7$	
2^9-1	$1+X^5+X^9$	
$2^{11}-1$	$1+X^9+X^{11}$	
$2^{15}-1$	$1+X^{14}+X^{15}$	
$2^{20}-1$	$1+X^3+X^{20}$	
$2^{23}-1$	$1+X^{18}+X^{23}$	
$2^{31}-1$	$1+X^{28}+X^{31}$	

N : Shift register
⊕ : Exclusive OR

What is the Zero-Subst pattern?

It is the pattern in which a set number of bits are substituted in the logic '0' pattern immediately after the longest continuous 0 bits of the pattern that adds 1 bit of the logic '1' pattern at the end of the PRBS pattern. However, when the bit immediately after the bit substituted by '0' is '0', it is inverted to '1'.

Example: PRBS having a 2^7 period

The 0 substitution starts from the following position because the longest number of continuous 0 is equal to 7–1 = 6 bits:

1000000 1000001100001010.... ←The PRBS pattern that has the 2^7 period

'1' is substituted by '0'.

Since the bit immediately after the one substituted by zero is '0', this bit is inverted to '1'.

11 bits

Zero Length

1000000 0000011

C.2 Printer Output Format

- Error/Alarm measurement immediate data

During error and alarm measurement, the Main window menu and File-Print are selected and the print format is shown when the Error/Alarm output is specified.
It is assumed here that MU177601B is inserted into Slots 1 to 4. Output contents vary depending on unit configuration and Independent/Combined Modes.

Note:

Printing contents change according to the setting and measurement statuses.

Measurement start time
Year/Month/Date Hour: Minute: Second

Print request generation time

MP1776A Error/Alarm Immediate Data

Start Time 97/03/12 14:25:00

Intermediate Time 97/03/12 14:26:00

Alarm Interval

	Clock Loss	Sync Loss
CH1, 3	*.****E**	*.****E**
CH2, 4	*.****E**	*.****E**

} Number of alarm occurrence intervals

Error

	ER	EC	EI	%EFI
CH1, 3	*.****E-**	*.****E**	*.****E**	***.****%
CH1	*.****E-**	*.****E**	****	****
CH3	*.****E-**	*.****E**	****	****
CH2, 4	*.****E-**	*.****E**	*.****E**	***.****%
CH2	*.****E-**	*.****E**	****	****
CH4	*.****E-**	*.****E**	****	****

} Error measurement items

Threshold EI

	>1E-3	>1E-4	>1E-5	>1E-6	>1E-7	>1E-8	=<1E-8
CH1, 3	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**
CH2, 4	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**

Threshold %EFI

	>1E-3	>1E-4	>1E-5	>1E-6	>1E-7	>1E-8	=<1E-8
CH1, 3	***.****%	***.****%	***.****%	***.****%	***.****%	***.****%	***.****%
CH2, 4	***.****%	***.****%	***.****%	***.****%	***.****%	***.****%	***.****%

} Threshold EI/%EFI

Continued ...

Error Performance

	ES	EFS	SES	US	DM	EC
CH1, 3	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**
CH2, 4	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**	*.****E**

Error Performance

	%ES	%EFS	%SES	%US	%DM
CH1, 3	***.****%	***.****%	***.****%	***.****%	***.****%
CH2, 4	***.****%	***.****%	***.****%	***.****%	***.****%

Performance measurement items

Clock Frequency

CH1, 3	*****.***MHz
CH2, 4	*****.***MHz

Frequency measurement

- Pattern

A case example is shown here where the Pattern Length for the PRGM pattern is set at 8388608 bits and output in hexadecimal notation.

Unit name

Output channel

MP1776A 12.5G ED Pattern (CH1)

```
          0                   64                  128
          +-------------------+-------------------+----------+
        0| 00 0A 3C EE 53 21 01 0E 48 FF C9 CC 67 85 4D 66 21 01 0E 48 |
      160| 01 02 03 55 CD CD E7 00 35 7E 54 A0 0B 5B 54 22 21 01 0E 48 |
        :|                    : Omitted along the way                  |
  8388480| DD CB 5E 90 26 71 A9 BA EE 87 77 20 00 03 FE 6D             |
          +-------------------+-------------------+----------+
```

C.3 Error/Alarm Measurement Details

- Explanation of measurement item terminology

(1) Error rate

$$\frac{\text{Number of error pulses to be measured within the measurement time}}{\text{Number of clocks to be measured within the measurement time}}$$

(2) Number of errors

Number of error pulses within the measurement time.

(3) Number of error intervals (EI)

Number of intervals that contain an error pulse or more within the measurement time.

The interval time is selected from among 10 ms, 100 ms, and 1 sec.

(4) Error free interval rate (%EFI)

The rate of the number of intervals, except for the those that contains one error pulse or more, within the measurement time to the total number of intervals.

It is calculated from EI by using the following formula:

$$\%EFI = \left(\frac{\text{Number of measured intervals} - EI}{\text{Number of measured intervals}} \right) \times 100\%$$

The interval time is selected from among 10 ms, 100 ms, and 1 sec.

(5) Number of clock loss intervals

Number of intervals that clock loss occurred.

(6) Number of sync loss intervals

Number of intervals that sync loss occurred.

(7) Threshold EI

Number of intervals that the one-second average error rate satisfies each of the following threshold conditions in the measurement time.

$>10^{-3}, >10^{-4}, >10^{-5}, >10^{-6}, >10^{-7}, > 10^{-8}, \leq 10^{-8}$

(8) Threshold %EFI

The rate of the number of intervals that the one-second average error rate did not satisfy each of the threshold conditions for Item (7) in the measurement time to the total number of intervals.

It is calculated from threshold EI by using the following formula:

$$\text{Threshold \%EFI} = \left(\frac{\text{Number of measured intervals}}{\text{Threshold EI}} \right) \times 100\%$$

- Error performance data

  This is the index parameter for transmission circuit evaluation prescribed in ITU-T (old CCITT) Rec. G821. The measurement period from start to end of measurement is divided into available period and unavailable period in one-second interval units. Various items are calculated mainly for the available period.

(1) Definition of unavailable and available periods

The unavailable period starts when such an interval (unavailable interval) continues for 10 seconds that the one-second average error rate exceeds the unavailable threshold. These 10 seconds are contained in the unavailable time.

The unavailable period ends when such an interval (available interval) continues for 10 seconds that the one-second average error rate does not exceed the unavailable threshold during the unavailable period. These 10 seconds are contained in the available time.

(2) Unavailable threshold/DM threshold

The unavailable threshold and the DM threshold can be selected from the following by using the Mainframe:Measurement panel:

Unavailable threshold = 10^{-3}, DM threshold = 10^{-6}

Unavailable threshold = 10^{-4}, DM threshold = 10^{-8}

(3) Measurement items

- Error Count (EC)

  This is the bit error count value in the measurement section.

- Error Second (ES)

  This is the total interval in which one bit error or more occurred in the available time.

- Error Free Second (EFS)

  This is the total interval in which no bit errors occurred in the available time.

- Severely Errored Second (SES)

  This is the total interval in which bit errors that exceed the unavailable threshold during the available time.

- Unavailable Time (US)

  When SES continues for 10 seconds or longer, the first one is judged to be the start of unavailable time. When other than SES continues for 10 seconds or longer, one before the first case shall be the end of unavailable time. The judgment counter is reset when the measurement period ended and the next measurement started during the judgment of start and end of unavailable time.

- Degraded Minutes (DM)
  The error rate is calculated for every packet consisting of 60 errors by excluding the above SES from the available interval calculated in the available time. The degraded minutes rate is the total packets in which the error rate exceeds the DM threshold. As for a section that is less than 60 seconds, 1 is added when that section exceeds the DM threshold at the end of measurement.
- Error Second Rate (%ES)
  This is the rate of error intervals calculated in the available time to all the intervals calculated in the available time.
- Error Free Second Rate (%EFS)
  This is the rate of error free intervals calculated in the available time to all the intervals calculated in the available time.
- Severely Errored Second Rate (%SES)
  This is the rate of unavailable intervals calculated in the available time to all the intervals calculated in the available time.
- Unavailable Time Rate (%US)
  This is the rate of the unavailable time to the measurement time.
- Degraded Minutes Rate (%DM)
  The error rate is calculated for every packet consisting of 60 errors by excluding the above SES from the available interval calculated in the available time. The degraded minutes rate is the rate of packets in which the error rate exceeds the DM threshold to all the packets.

- Measured data process at the time of alarm

  There is the clock loss alarm, the sync loss alarm.

  When an alarm occurs during measurement, the following two processes can be selected.

  (a) Excluding alarm occurrences from the calculation

  (i) Error measurement

  Number of errors and number of clocks counted during the interval an alarm occurred are excluded from the calculation.

  (ii) Interval measurement and threshold interval measurement

  Intervals an alarm occurred are calculated only for each alarm intervals and not calculated for other items.

  (iii) Error performance

  Intervals an alarm occurred are not calculated for both the unavailable time and the available time. In addition, intervals under judgment are not calculated for both the unavailable time and the available time.

  Measurement is continued from the initial status after the alarm is restored.

  (b) Including alarm occurrences in the calculation

  (i) Error measurement

  Number of errors and number of clocks counted during the interval an alarm occurred are excluded from the calculation.

  (ii) Interval measurement and threshold interval measurement

  Intervals an alarm occurred are calculated for each alarm interval and the number of all intervals, but not calculated for the number of threshold EIs.

  (iii) Error performance

  Intervals an alarm occurred are the unavailable intervals that are calculated for the number of error seconds if they are calculated for the available time.

C.4 Basic Terms for Windows®

Since Windows® is used in the MP1776, Windows® terms are sometimes used in the description of the MP1776. Windows® terms and operations are explained here that are frequently used in this operation manual.

General terms

General terms used in the operation manual are explained (the explanation assumes mouse-use).

- Mouse pointer
  The mouse position on the screen can be confirmed by graphics called "mouse pointer" on the screen. The pointer shape changes to the arrow or the hourglass depending on the pointer position and the application operation.
- To click
  To press and to release the mouse button at a certain position.
- To double-click
  To press and to release the mouse button quickly twice at a certain position.
- To drag
  To move the mouse by pressing the mouse button.
- To drop
  To release the mouse button after dragging.
- Controls
  Objects such as buttons, text boxes, etc. located on the screen. Controls are used to display results and to select items.
- Focus
  Enabling the next input is called "having the focus". For example, the focus is indicated by the box of dotted-lines or the highlighted display when there are several controls on the screen.

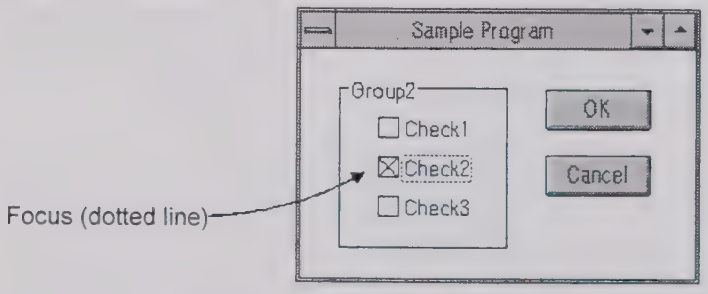


Fig. C-1 Example focus set on the check box

Note:

The screen can be operated by touching the touch panel that is installed on the screen of this instrument. Operating the touch panel and mouse are almost the same except for the right mouse button function. Operate them by thinking that pressing the left mouse button is like touching the screen with a finger or the pen.

Each window component

Window components are explained.

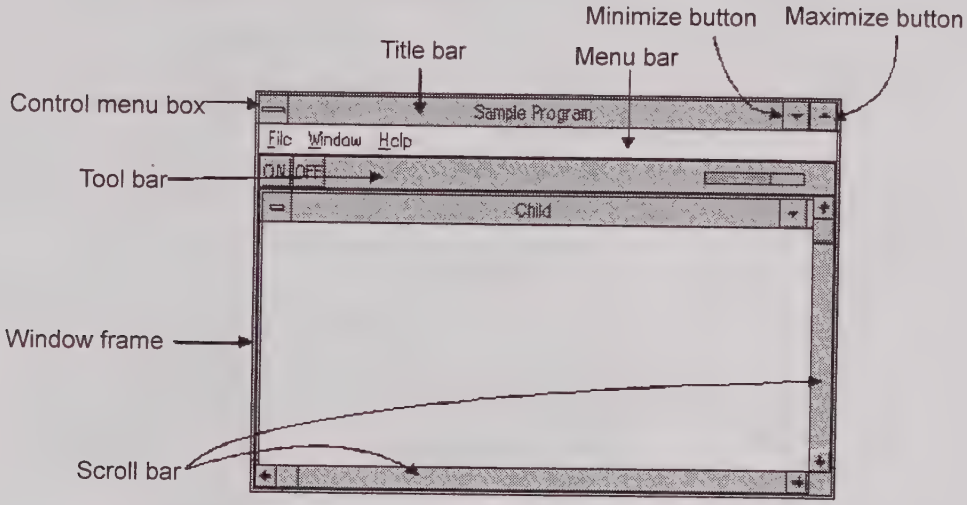


Fig. C-2 Window components

- Title bar

  The title, the control menu box, the minimize button, and the maximize button, etc. are provided.
- Title

  Indicates the label to show the window function.
- Control menu box

  The window is closed by double-clicking this box. The control menu is opened by clicking again. The control menu allows you to maximize and minimize the window.

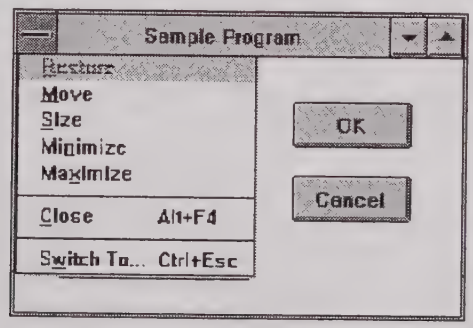


Fig. C-3 Control menu

- Minimize button
  The window is minimized when this button is clicked. The window is usually minimized.
- Maximize button
  The window is maximized when this button is clicked.
- Menu bar
  The area where the menu titles are displayed is called as the menu bar.
- Menu title
  It indicates the character string displayed on the menu bar. The dropdown menu is displayed when the menu title is clicked. The process corresponding to the item is started when the item desired is clicked by selecting from among the displayed menu items (Fig. C-4).

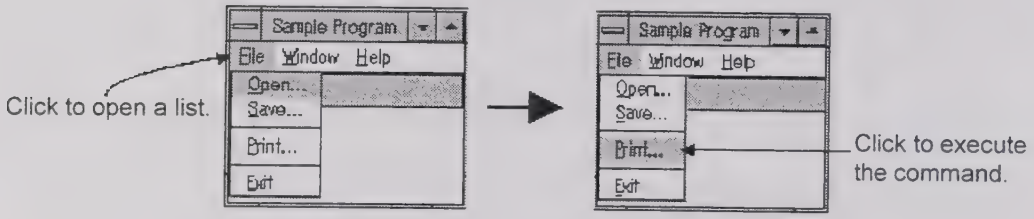


Fig. C-4 Menu selection method

There are also menu items to select an enabled item from among multiple items. A check mark can be added to the enabled item (Fig. C-5).

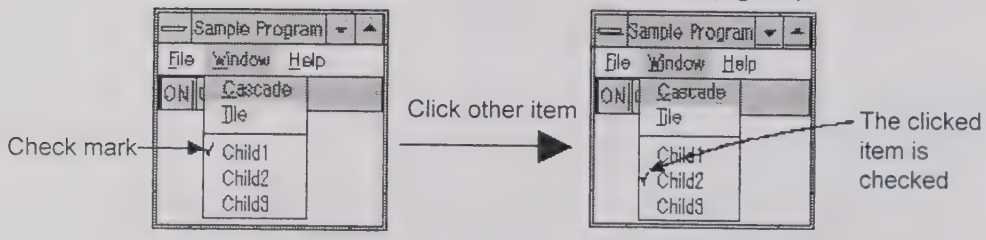


Fig. C-5 Menu with check mark added

- Tool bar
  Indicates the area where frequently used functions are displayed corresponding to buttons, etc.
- Scroll bar
  The scroll bar is displayed when the entire information cannot be displayed on the screen. The hidden information can be shown by moving the scroll bar.
- Window frame
  The frame to indicate the boundary lines for one window.

Window operation

Basic window operations are explained.

- To minimize the window
  The window is minimized when the minimize button on the upper right corner of the window is clicked.
- To display the window from the icon
  Place the mouse pointer on the icon and double-click it to display the window.

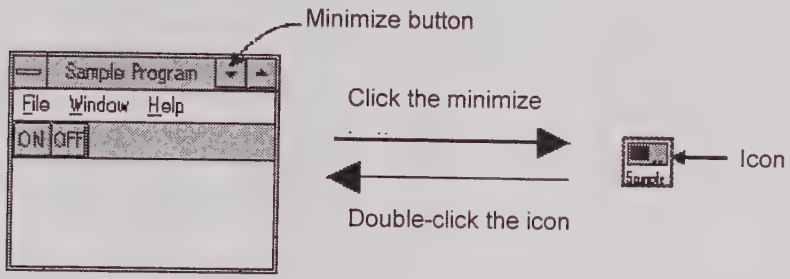


Fig. C-6 Icon and window displays

- To maximize the window
  The window is maximized when the maximize button on the window is clicked. It is also maximized by double-clicking the title bar. When the window is maximized, the maximize button changes to the restore button.
- To return to the original size from the maximized window
  Click the restore button or double-click the title bar to return to the original size from the maximized window.

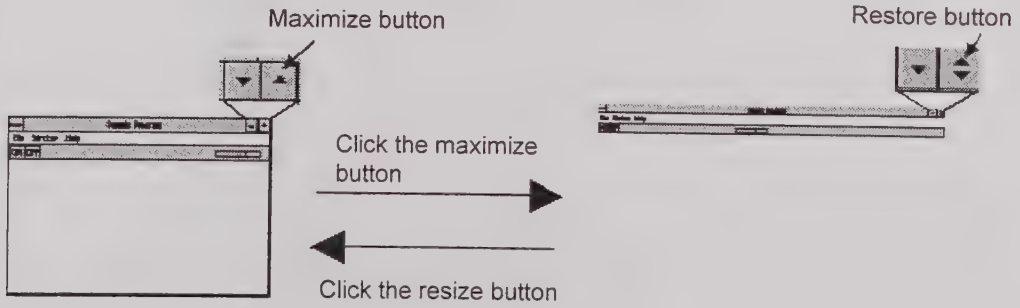


Fig. C-7 Maximizing and restoring

- To freely change the window size

  The arrow is displayed to show the direction to change the size when the mouse pointer is placed on the window boundary. Drag the mouse by holding the pressed left mouse button to the desired size and release the button.
- To move the displayed window position

  Place the mouse pointer on the window title bar and hold the pressed left mouse button. Drag the mouse to the desired window location and release the left mouse button.
- To move the icon position

  Place the mouse pointer on the icon and hold the pressed left mouse button. Drag the mouse to the desired icon location and release the left mouse button.
- To move focus between controls

  Click the control to move the focus to the desired control when multiple controls are present in a window. The focus is set on the clicked control. Otherwise, press the [Tab] key and the [Shift]+[Tab] key. The focus moves among controls in the window.

Controls

Controls used in the MP1776 are explained.

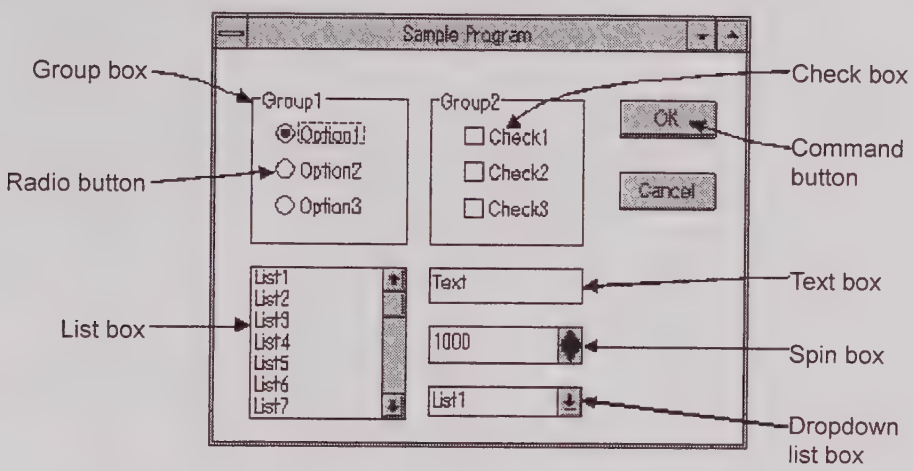


Fig. C-8 Controls

- Command button

  The rectangular button displaying the label to indicate a function. Press the button to execute the corresponding function. (This instrument also has a toggle button that has both the pressed status and released status, and also a selection button to select one among multiple buttons).

- Radio button

  The button to select one item among multiple items. Click the item desired button. When selected, a black dot is displayed in the button. Select one from the group box where similar items are usually gathered.

- Check box

  The button to simultaneously select multiple items. Click the desired items buttons. When they are selected, x is displayed in the squares.

- List box

  The box to display a list of items that can be selected. Click the item in the list to select. The selected item is highlighted. There is the standard list box to select only one from the list and the expanded selection list box to select multiple items.

- Dropdown list box

  A function that is the same as the above list box. Only the selected items are usually displayed. Press the arrow button to display the list and click the item in the list to select.

- Text box

  The box to enable input and edit. There is a cursor in the box to input and to edit.

- Spin box
  Consisting of the text box and the arrow button to be used for numerical value input. The numerical value can be increased and decreased with the arrow button. In addition, any value can be directly input by using the numerical value key on the front panel.
- Group box
  A box to group related items between controls.

Appendix D Entry Table of Performance Test Result

Instrument Name: MP1776A
Serial No.: _____
Ambient Temperature: _____°C
Ambient Humidity: _____%

Item	CH select	Expectation	Result
7.3.1 Operation frequency (Independent)	CH1	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	CH2	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	CH3	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	CH4	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
(Combined)		The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	

Item	CH select	Expectation	Result
7.3.2 Input data level	Setting order [1]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	Setting order [2]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	Setting order [3]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	Setting order [4]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	

Item	CH select	Expectation	Result
7.3.3 Input clock level	Setting order [1]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	Setting order [2]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	Setting order [3]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	Setting order [4]	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	

Item	CH select	Expectation	Result
7.3.4 Pattern	$PRBS2^7-1$	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	$PRBS2^9-1$	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	$PRBS\,2^{11}-1$	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	$PRBS2^{15}-1$	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	$PRBS\,2^{20}-1$	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	$PRBS2^{23}-1$	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	
	$PRBS2^{31}-1$	The ERRORS lamp of the MP1776A is not turned ON, after Auto Search complection.	

Item	CH select	Specification	Result
7.3.5 Measurements items	Error rate	1.0000E-11	
	Number of errors	1	
	Error interval (EI)	1	
	Error free interval (EFI)	90.0000%	
	Clock frequency	9999.899 to 10000.101 MHz	

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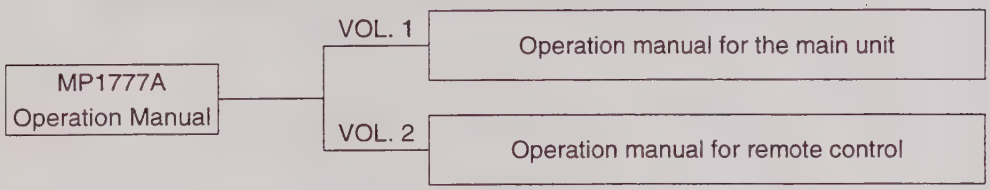
Composition of the MP1777A Operation Manual

The operation manual for the MP1777A 10 GHz Jitter Analyzer is composed of the two volumes shown below. Use the volume that suits the intended application of the product.



Operation manual for the main unit: This manual provides an outline of the MP1777A and its specifications, and describes its panel, performance and operation.

Operation manual for remote control: This manual describes remote control and provides program examples.

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1.1 Product Description

The MP1777A 10 GHz Jitter Analyzer provides functions to generate jitter and perform measurement necessary to evaluate the quality of digital transmission circuit.

Moreover, the combination of the 10/12.5/15 G PPG, 10/12.5/15 G ED, and MS4630A/B Network Analyzer enables the basic jitter measurement listed below with an external PC (personal computer) to function as a controller.

Basic jitter measurement

(1) Jitter tolerance measurement
(2) Jitter transfer measurement
(3) Jitter generation measurement (rms measurement, With HP+LP)
(4) Output jitter measurement (peak to peak measurement, With HP1+LP, HP2+LP)

1.2 Specification

1.2.1 Standard

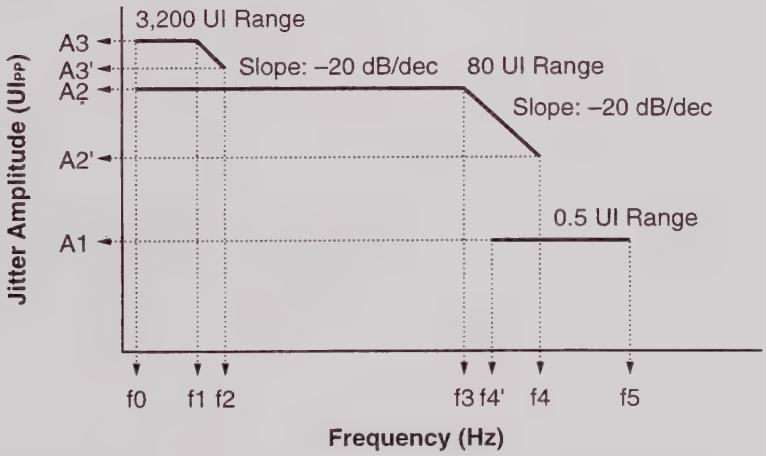
Section	Specification Item	Standard Specification Value
1	Jitter Clock Output	
1.1	Frequency	2,488.32 MHz, 4,976.64 MHz, 9,953.28 MHz
1.2	Termination/Level	50 Ω/+5 dBm ± 3 dB
1.3	Connector	APC 3.5 (Clock Output)
2	Jitter Clock Input	
2.1	Frequency	2,488.32 MHz ±50 ppm, 4,976.64 MHz ±30 ppm, 9,953.28 MHz ±20 ppm
2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP} 0.15 V to 1.3 V_{PP} (with Option 10)
2.3	Connector	APC 3.5 (Clock Input)
3	Ext. Ref. Clock Input	
3.1	Frequency	155.52 MHz ±50 ppm
3.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
3.3	Connector	SMA (Clock Input)
4	DCS Input	
4.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
4.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
4.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)

Section	Specification Item	Standard Specification Value		
5	Ext. Mod. Input			
5.1	Frequency range	100 kHz to 80 MHz	(at 0.5 UI Range/9,953.28 Mbit/s)	
		100 kHz to 40 MHz	(at 0.5 UI Range/4,976.64 Mbit/s)	
		100 kHz to 20 MHz	(at 0.5 UI Range/2,488.32 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
5.2	Sensitivity	(0.5 UI Range)		
		0.5 UI_{PP} ±15 %/0.5 V_{PP}	(at 9,953.28 Mbit/s)	
		0.5 UI_{PP} ±15 %/1 V_{PP}	(at 4,976.64 Mbit/s)	
		0.5 UI_{PP} ±15 %/2 V_{PP}	(at 2,488.32 Mbit/s)	
		(3,200 UI, 1,600 UI, 800 UI, 80 UI, 40 UI, 20 UI Range)		
		3,200 Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(9,953.28 Mbit/s only)
		1,600 Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(4,976.64 Mbit/s only)
		800 Range:	800 UI_{PP} ±15 %/1 V_{PP}	(2,488.32 Mbit/s only)
		80 Range:	80 UI_{PP} ±15 %/1 V_{PP}	(9,953.28 Mbit/s only)
		40 Range:	40 UI_{PP} ±15 %/1 V_{PP}	(4,976.64 Mbit/s only)
		20 Range:	20 UI_{PP} ±15 %/1 V_{PP}	(2,488.32 Mbit/s only)
5.3	Termination	50 Ω		
5.4	Connector	BNC (Ext. Mod. Input)		
6	Demod. Output			
6.1	Frequency range	100 Hz to 80 MHz		
6.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range), 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)		
6.3	Termination	50 Ω		
6.4	Connector	BNC (Demod. Output)		
7	10M STD Input			
7.1	Frequency range	10 MHz ±50 ppm		
7.2	Level	0 to +10 dBm		
7.3	Termination	50 Ω		
7.4	Connector	BNC		

Section	Specification Item	Standard Specification Value
8		
8.1	**[Clock mode]**	
	CLOCK	Internal, External, Lock 2 MHz (B), Lock 2 MHz (UB), Lock 2 Mbit/s (B), Lock 2 Mbit/s (UB), Lock 1.5 MHz (UB), Lock 1.5 Mbit/s (B), Lock 10 M
8.1.1	Internal	Reference signal synchronous with the internal reference signal
	Accuracy	±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)
8.1.2	External	Reference signal synchronous with the incoming signal from the Ext. Ref. Clock Input
8.1.2.1	Frequency	155.52 MHz ±50 ppm
8.1.2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
8.1.2.3	Connector	SMA
8.1.3	DCS Input	Reference signal synchronous with the incoming signal from the DCS Input
8.1.3.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
8.1.3.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
8.1.3.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)
8.1.4	10M STD Input	Reference signal synchronous with the incoming signal from the 10M STD Input
8.1.4.1	Frequency range	10 MHz ±50 ppm
8.1.4.2	Level	0 to +10 dBm
8.1.4.3	Termination	50 Ω
8.1.4.4	Connector	BNC
8.2	**[Variable frequency]**	
8.2.1	Frequency range	±50 ppm
8.2.2	Step	0.1 ppm
8.2.3	Accuracy	±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)

Section	Specification Item	Standard Specification Value		
8.3	**[Jitter generation]**			
8.3.1	Bit Rate	2,488.32 Mbit/s, 4,976.64 Mbit/s, 9,953.28 Mbit/s		
8.4	Jitter modulating signal			
8.4.1	Ext. Mod. Input	Connector for external modulating signal input		
8.4.1.1	Frequency range	100 kHz to 80 MHz	(at 0.5 UI Range/9,953.28 Mbit/s)	
		100 kHz to 40 MHz	(at 0.5 UI Range/4,976.64 Mbit/s)	
		100 kHz to 20 MHz	(at 0.5 UI Range/2,488.32 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
8.4.1.2	Waveform	Sine wave		
8.4.1.3	Sensitivity	3,200 UI Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(9,953.28 Mbit/s only)
		1,600 UI Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(4,976.64 Mbit/s only)
		800 UI Range:	800 UI_{PP} ±15 %/1 V_{PP}	(2,488.32 Mbit/s only)
		80 UI Range:	80 UI_{PP} ±15 %/1 V_{PP}	(9,953.28 Mbit/s only)
		40 UI Range:	40 UI_{PP} ±15 %/1 V_{PP}	(4,976.64 Mbit/s only)
		20 UI Range:	20 UI_{PP} ±15 %/1 V_{PP}	(2,488.32 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/0.5 V_{PP}	(at 9,953.28 Mbit/s)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/1 V_{PP}	(at 4,976.64 Mbit/s)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/2 V_{PP}	(at 2,488.32 Mbit/s)
8.4.1.4	Termination	50 Ω		
8.4.1.5	Connector	BNC (Ext. Mod. Input)		
8.4.1.6	Equalizer Amp	Selection of Equalizer Amp. to suit the jitter tolerance mask enabled (9,953.28 Mbit/s only)		

Section	Specification Item	Standard Specification Value		
8.5	Jitter modulation			
8.5.1	Range	3,200 UI Range:	Up to 3,200 UI_{PP}	(9,953.28 Mbit/s only)
		1,600 UI Range:	Up to 1,600 UI_{PP}	(4,976.64 Mbit/s only)
		800 UI Range:	Up to 800 UI_{PP}	(2,488.32 Mbit/s only)
		80 UI Range:	Up to 80 UI_{PP}	(9,953.28 Mbit/s only)
		40 UI Range:	Up to 40 UI_{PP}	(4,976.64 Mbit/s only)
		20 UI Range:	Up to 20 UI_{PP}	(2,488.32 Mbit/s only)
		0.5 UI Range:	Up to 0.5 UI_{PP}	
8.5.2	Amount of modulation	**[Bit Rate: at 9,953.28 Mbit/s]**		

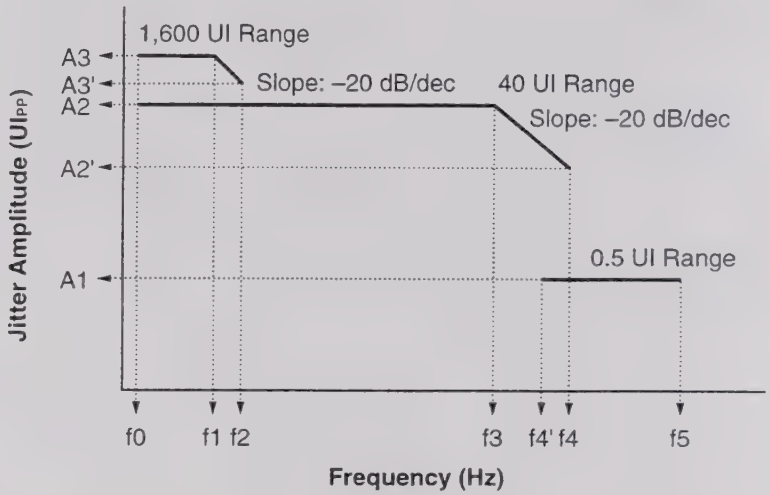


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
9,953.28 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
80 MHz	0.5 UI_{PP}	4 UI_{PP}	80 UI_{PP}	100 UI_{PP}	3,200 UI_{PP}

Section	Specification Item	Standard Specification Value

[Bit Rate: at 4,976.64 Mbit/s]

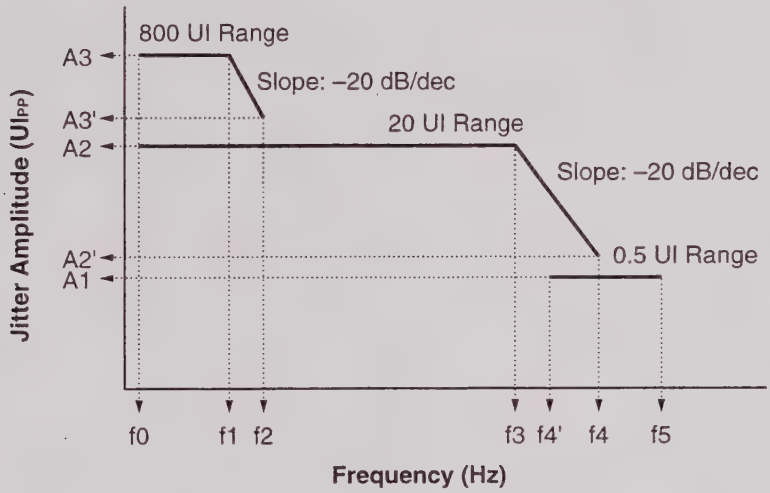


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
4,976.64 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
40 MHz	0.5 UIPP	2 UIPP	40 UIPP	50 UIPP	1,600 UIPP

Section	Specification Item	Standard Specification Value

[Bit Rate: at 2,488.32 Mbit/s]



Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
2,488.32 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
20 MHz	0.5 UI_{PP}	1 UI_{PP}	20 UI_{PP}	25 UI_{PP}	800 UI_{PP}

8.5.3 Accuracy

3,200 UI Range:	±5 % ±10 UI_{PP}/at 10 Hz	(at 9,953.28 Mbit/s)
1,600 UI Range:	±5 % ± 8 UI_{PP}/at 10 Hz	(at 4,976.64 Mbit/s)
800 UI Range:	±5 % ± 5 UI_{PP}/at 10 Hz	(at 2,488.32 Mbit/s)
80 UI Range:	±5 % ±0.8 UI_{PP}/at 100 kHz	(at 9,953.28 Mbit/s)
40 UI Range:	±5 % ±0.6 UI_{PP}/at 100 kHz	(at 4,976.64 Mbit/s)
20 UI Range:	±5 % ±0.3 UI_{PP}/at 100 kHz	(at 2,488.32 Mbit/s)
0.5 UI Range:	±5 % ±0.1 UI_{PP}/at 100 kHz	(at 9,953.28 Mbit/s)
	±5 % ±0.08 UI_{PP}/at 100 kHz	(at 4,976.64 Mbit/s)
	±5 % ±0.05 UI_{PP}/at 100 kHz	(at 2,488.32 Mbit/s)

Frequency error (100 kHz set as the reference)

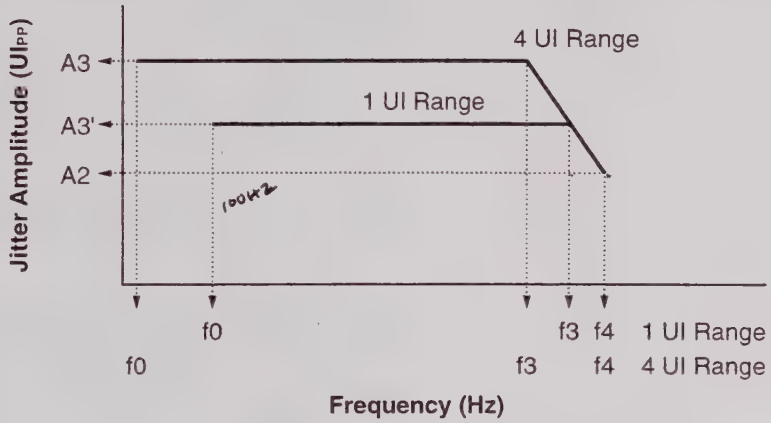
10 Hz to 20 Hz: ±5 %
20 Hz to 300 kHz: ±2 %
300 kHz to 1 MHz: ±3 %
1 MHz to 3 MHz: ±5 %
3 MHz to 10 MHz: ±10 %
10 MHz to 80 MHz: ±15 %

Section	Specification Item	Standard Specification Value
8.6	**[Jitter measurement]** Jitter signal input	Jitter tolerance
8.6.1	Frequency	2,488.32 MHz ±50 ppm, 4,976.64 MHz ±30 ppm, 9,953.28 MHz ±20 ppm
8.7	Jitter demodulating signal	
8.7.1	Demod. Output	Output of signal demodulated from the incoming signal
8.7.1.1	Frequency range	100 Hz to 80 MHz
8.7.1.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range) 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)
8.7.1.3	Termination	50 Ω
8.7.1.4	Connector	BNC
8.8	Jitter measurement	
8.8.1	Unit	UI_{PP}, UI+p, UI–p, UIrms
8.8.2	Measurement range	1 UI Range (0.000 to 1.010 UI_{PP}/Step 0.001 UI_{PP}) (0.000 to 0.357 UIrms/Step 0.001 UIrms) 4 UI Range (0.00 to 4.04 UI_{PP}/Step 0.01 UI_{PP}) (0.00 to 1.43 UIrms/Step 0.01 UIrms)
8.8.3	Measurement mode	Single, Repeat, Manual
8.8.4	Measurement interval	1 to 99 (second) (1-second step) 1 to 99 (minute) (1-minute step) 1 to 99 (hour) (1-hour step)
8.8.5	Measurement display	Current, Last
8.8.6	Filter	LP, HP1+LP, HP2+LP, HP+LP, HP'+LP

Bit Rate (bit/s)	HP1	HP2	HP'	HP	LP
2,488.32 M	5 kHz	1 MHz	–	12 kHz	20 MHz
4,976.64 M	8 kHz	2 MHz	–	12 kHz	40 MHz
9,953.28 M	10 kHz	4 MHz	50 kHz	12 kHz	80 MHz

Section	Specification Item	Standard Specification Value

8.8.7 Measuring range



Bit Rate (bit/s)	Range	f0	f3	f4	A2	A3'	A3
2,488.32 M	1 UI	100 Hz	10 MHz	20 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	2.5 MHz	20 MHz	0.5 UIPP	–	4 UIPP
4,976.64 M	1 UI	100 Hz	20 MHz	40 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	5 MHz	40 MHz	0.5 UIPP	–	4 UIPP
9,953.28 M	1 UI	100 Hz	40 MHz	80 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	10 MHz	80 MHz	0.5 UIPP	–	4 UIPP

Section	Specification Item	Standard Specification Value
8.8.8	Accuracy	**[UIPP, UI+p, UI–p]** 1 UI Range: ±5 % ±W UIPP/at 100 kHz 4 UI Range: ±5 % ±W UIPP/at 100 kHz **[UIrms]** 1 UI Range: ±5 % ±Y UIrms/at 100 kHz 4 UI Range: ±5 % ±Y UIrms/at 100 kHz

Bit Rate (bit/s)	W*1		Y*2	
	1 UI Range	4 UI Range	1 UI Range	4 UI Range
2,488.32 M	0.05 UIPP	0.22 UIPP	0.008 UIrms	0.08 UIrms
4,976.64 M	0.07 UIPP	0.24 UIPP	0.009 UIrms	0.09 UIrms
9,953.28 M	0.09 UIPP	0.26 UIPP	0.010 UIrms	0.10 UIrms

NOTE *1:

With HP1+LP

NOTE *2:

With HP+LP

Frequency error (100 kHz set as the reference)

100 Hz to 300 kHz: ±2 %
300 kHz to 1 MHz: ±3 %
1 MHz to 3 MHz: ±5 %
3 MHz to 10 MHz: ±10 %
10 MHz to 80 MHz: ±15 %

8.9	LED display	Unlock, Alarm, Remote
8.9.1	Unlock	Lights up when the Rx section switches into the unlock status.
8.9.2	Alarm	Lights up when the Tx section switches into the abnormal status (such as unlock).
8.9.3	Remote	Lights up when the mode switches into the remote status by the external controller.
8.10	External interface	
8.10.1	GPIB	All the control except for cancellation of remote status enabled from the external controller
8.11	Other	
8.11.1	Dimensions	221.5 High, 426 Wide, 451 Deep (mm)
8.11.2	Weight	23 kg (Max.)
8.11.3	Power source	85 to 132 Vac or 170 to 250 Vac 47.5 to 63 Hz
8.11.4	Temperature	10 to 40 °C, –20 to 60 °C (When stored)

1.2.2 Option 01

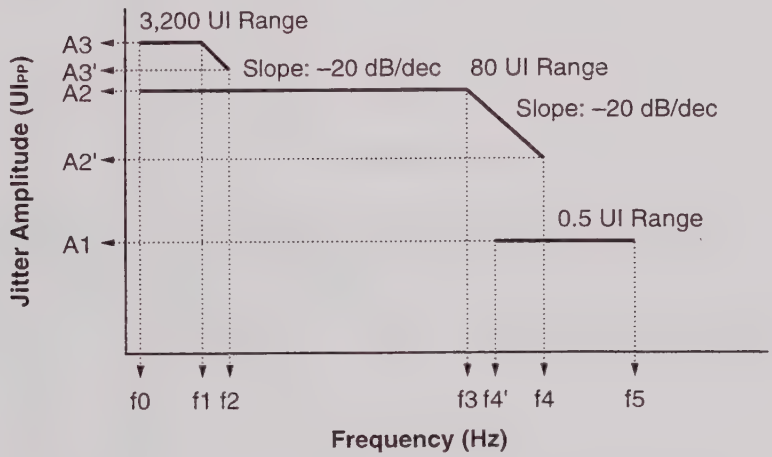
Section	Specification Item	Standard Specification Value
1	Jitter Clock Output	
1.1	Frequency	2,494.16 MHz, 4,988.32 MHz, 9,976.64 MHz
1.2	Termination/Level	50 Ω/+5 dBm ±3 dB
1.3	Connector	APC 3.5 (Clock Output)
2	Jitter Clock Input	
2.1	Frequency	2,494.16 MHz ±50 ppm, 4,988.32 MHz ±30 ppm, 9,976.64 MHz ±20 ppm
2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP} 0.15 V to 1.3 V_{PP} (with Option 10)
2.3	Connector	APC 3.5 (Clock Input)
3	Ext. Ref. Clock Input	
3.1	Frequency	155.885 MHz
3.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
3.3	Connector	SMA (Clock Input)
4	DCS Input	
4.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
4.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
4.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)

Section	Specification Item	Standard Specification Value		
5	Ext. Mod. Input			
5.1	Frequency range	100 kHz to 80 MHz	(at 0.5 UI Range/9,976.64 Mbit/s)	
		100 kHz to 40 MHz	(at 0.5 UI Range/4,988.32 Mbit/s)	
		100 kHz to 20 MHz	(at 0.5 UI Range/2,494.16 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
5.2	Sensitivity	(0.5 UI Range)		
		0.5 UI_{PP} ±15 %/0.5 V_{PP}	(at 9,976.64 Mbit/s)	
		0.5 UI_{PP} ±15 %/1 V_{PP}	(at 4,988.32 Mbit/s)	
		0.5 UI_{PP} ±15 %/2 V_{PP}	(at 2,499.16 Mbit/s)	
		(3,200 UI, 1,600 UI, 800 UI, 80 UI, 40 UI, 20 UI Range)		
		3,200 Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(9,976.64 Mbit/s only)
		1,600 Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(4,988.32 Mbit/s only)
		800 Range:	800 UI_{PP} ±15 %/1 V_{PP}	(2,494.16 Mbit/s only)
		80 Range:	80 UI_{PP} ±15 %/1 V_{PP}	(9,976.64 Mbit/s only)
		40 Range:	40 UI_{PP} ±15 %/1 V_{PP}	(4,988.32 Mbit/s only)
		20 Range:	20 UI_{PP} ±15 %/1 V_{PP}	(2,499.16 Mbit/s only)
5.3	Termination	50 Ω		
5.4	Connector	BNC (Ext. Mod. Input)		
6	Demod. Output			
6.1	Frequency range	100 Hz to 80 MHz		
6.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range), 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)		
6.3	Termination	50 Ω		
6.4	Connector	BNC (Demod. Output)		
7	10M STD Input			
7.1	Frequency range	10 MHz ±50 ppm		
7.2	Level	0 to +10 dBm		
7.3	Termination	50 Ω		
7.4	Connector	BNC		

Section	Specification Item	Standard Specification Value
8		
8.1	**[Clock mode]**	
	CLOCK	Internal, External, Lock 2 MHz (B), Lock 2 MHz (UB), Lock 2 Mbit/s (B) Lock 1.5 Mbit/s (UB), Lock 1.5 MHz (UB), Lock 1.5 Mbit/s (B), Lock 10 M
8.1.1	Internal Accuracy	Reference signal synchronous with the internal reference signal ±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)
8.1.2	External	Reference signal synchronous with the incoming signal from the Ext. Ref. Clock Input
8.1.2.1	Frequency	155.885 MHz ±50 ppm
8.1.2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
8.1.2.3	Connector	SMA
8.1.3	DCS Input	Reference signal synchronous with the incoming signal from the DCS Input
8.1.3.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
8.1.3.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
8.1.3.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)
8.1.4	10M STD Input	Reference signal synchronous with the incoming signal from the 10M STD Input
8.1.4.1	Frequency range	10 MHz ±50 ppm
8.1.4.2	Level	0 to +10 dBm
8.1.4.3	Termination	50 Ω
8.1.4.4	Connector	BNC
8.2	**[Variable frequency]**	
8.2.1	Frequency range	±50 ppm
8.2.2	Step	0.1 ppm
8.2.3	Accuracy	±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)

Section	Specification Item	Standard Specification Value		
8.3	**[Jitter generation]**			
8.3.1	Bit Rate	2,494.16 Mbit/s, 4,988.32 Mbit/s, 9,976.64 Mbit/s		
8.4	Jitter modulating signal			
8.4.1	Ext. Mod. Input	Connector for external modulating signal input		
8.4.1.1	Frequency range	100 kHz to 80 MHz	(0.5 UI Range/9,976.64 Mbit/s)	
		100 kHz to 40 MHz	(0.5 UI Range/4,988.32 Mbit/s)	
		100 kHz to 20 MHz	(0.5 UI Range/2,494.16 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
8.4.1.2	Waveform	Sine wave		
8.4.1.3	Sensitivity	3,200 UI Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(9,976.64 Mbit/s only)
		1,600 UI Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(4,988.32 Mbit/s only)
		800 UI Range:	800 UI_{PP} ±15 %/1 V_{PP}	(2,494.16 Mbit/s only)
		80 UI Range:	80 UI_{PP} ±15 %/1 V_{PP}	(9,976.64 Mbit/s only)
		40 UI Range:	40 UI_{PP} ±15 %/1 V_{PP}	(4,988.32 Mbit/s only)
		20 UI Range:	20 UI_{PP} ±15 %/1 V_{PP}	(2,494.16 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/0.5 V_{PP}	(9,976.64 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/1 V_{PP}	(4,988.32 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/2 V_{PP}	(2,494.16 Mbit/s only)
8.4.1.4	Termination	50 Ω		
8.4.1.5	Connector	BNC (Ext. Mod. Input)		
8.4.1.6	Equalizer Amp	Selection of Equalizer Amp. to suit the jitter tolerance mask enabled (9,976.64 Mbit/s only)		

Section	Specification Item	Standard Specification Value		
8.5	Jitter modulation			
8.5.1	Range	3,200 UI Range:	Up to 3,200 UI_{PP}	(9,976.64 Mbit/s only)
		1,600 UI Range:	Up to 1,600 UI_{PP}	(4,988.32 Mbit/s only)
		800 UI Range:	Up to 800 UI_{PP}	(2,494.16 Mbit/s only)
		80 UI Range:	Up to 80 UI_{PP}	(9,976.64 Mbit/s only)
		40 UI Range:	Up to 40 UI_{PP}	(4,988.32 Mbit/s only)
		20 UI Range:	Up to 20 UI_{PP}	(2,494.16 Mbit/s only)
		0.5 UI Range:	Up to 0.5 UI_{PP}	
8.5.2	Amount of modulation	**[Bit Rate: at 9,976.64 Mbit/s]**		

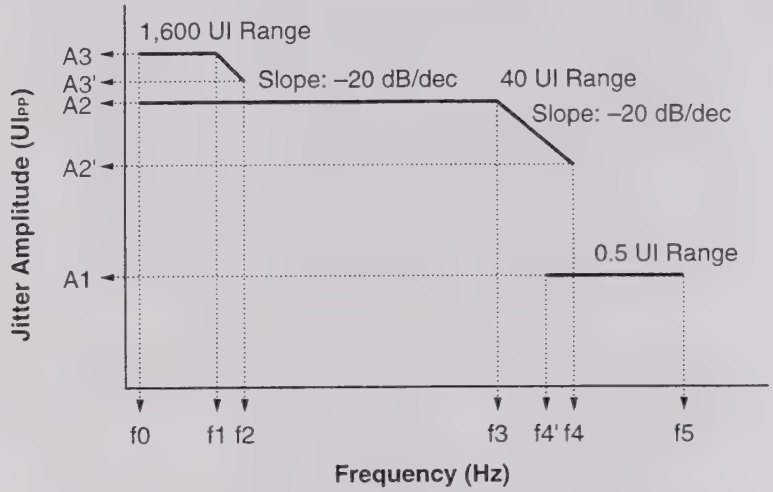


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
9,976.64 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
80 MHz	0.5 UI_{PP}	4 UI_{PP}	80 UI_{PP}	100 UI_{PP}	3,200 UI_{PP}

Section	Specification Item	Standard Specification Value

[Bit Rate: at 4,988.32 Mbit/s]

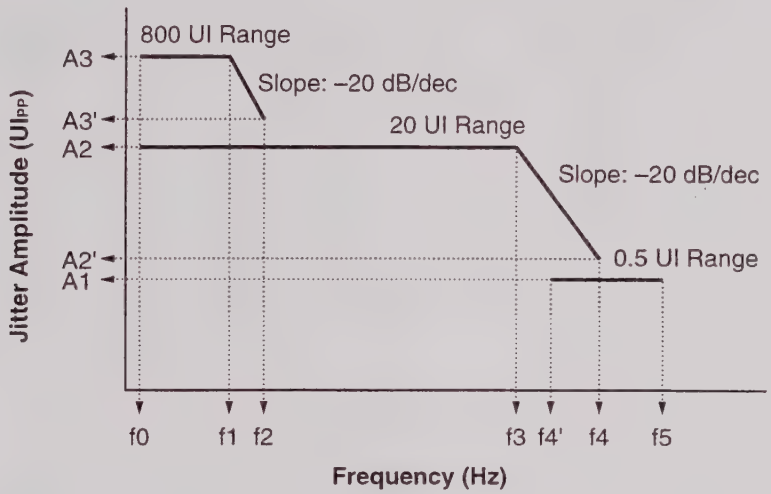


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
4,988.32 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
40 MHz	0.5 UIPP	2 UIPP	40 UIPP	50 UIPP	1,600 UIPP

Section	Specification Item	Standard Specification Value

[Bit Rate: at 2,494.16 Mbit/s]



Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
2,494.16 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
20 MHz	0.5 UIPP	1 UIPP	20 UIPP	25 UIPP	800 UIPP

8.5.3 Accuracy

3,200 UI Range:	±5 % ±10 UIPP/at 10 Hz	(at 9,976.64 Mbit/s)
1,600 UI Range:	±5 % ± 8 UIPP/at 10 Hz	(at 4,988.32 Mbit/s)
800 UI Range:	±5 % ± 5 UIPP/at 10 Hz	(at 2,494.16 Mbit/s)
80 UI Range:	±5 % ±0.8 UIPP/at 100 kHz	(at 9,976.64 Mbit/s)
40 UI Range:	±5 % ±0.6 UIPP/at 100 kHz	(at 4,988.32 Mbit/s)
20 UI Range:	±5 % ±0.3 UIPP/at 100 kHz	(at 2,494.16 Mbit/s)
0.5 UI Range:	±5 % ±0.1 UIPP/at 100 kHz	(at 9,976.64 Mbit/s)
	±5 % ±0.08 UIPP/at 100 kHz	(at 4,988.32 Mbit/s)
	±5 % ±0.05 UIPP/at 100 kHz	(at 2,494.16 Mbit/s)

Frequency error (100 kHz set as the reference)

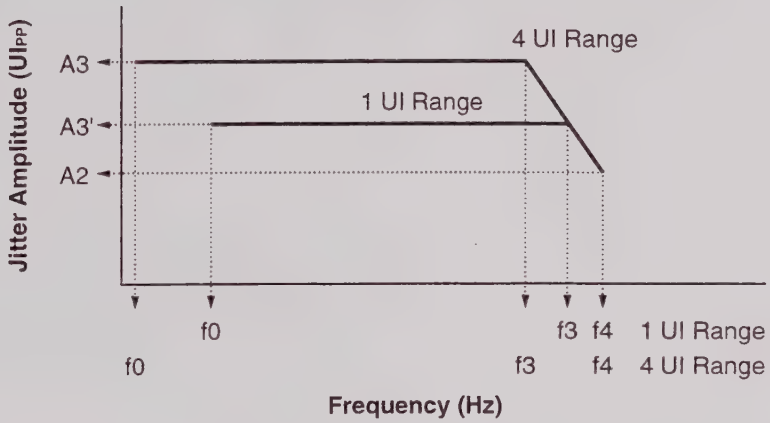
10 Hz to 20 Hz: ±5 %
20 Hz to 300 kHz: ±2 %
300 kHz to 1 MHz: ±3 %
1 MHz to 3 MHz: ±5 %
3 MHz to 10 MHz: ±10 %
10 MHz to 80 MHz: ±15 %

Section	Specification Item	Standard Specification Value
8.6	**[Jitter measurement]** Jitter signal input	
8.6.1	Frequency	2,494.16 MHz ±50 ppm, 4,988.32 MHz ±30 ppm, 9,976.64 MHz ±20 ppm
8.7	Jitter demodulating signal	
8.7.1	Demod. Output	Output of signal demodulated from the incoming signal
8.7.1.1	Frequency range	100 Hz to 80 MHz
8.7.1.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range) 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)
8.7.1.3	Termination	50 Ω
8.7.1.4	Connector	BNC
8.8	Jitter measurement	
8.8.1	Unit	UI_{PP}, UI+p, UI–p, UIrms
8.8.2	Measurement range	1 UI Range (0.000 to 1.010 UI_{PP}/Step 0.001 UI_{PP}) (0.000 to 0.357 UIrms/Step 0.001 UIrms) 4 UI Range (0.00 to 4.04 UI_{PP}/Step 0.01 UI_{PP}) (0.00 to 1.43 UIrms/Step 0.01 UIrms)
8.8.3	Measurement mode	Single, Repeat, Manual
8.8.4	Measurement interval	1 to 99 (second) (1-second step) 1 to 99 (minute) (1-minute step) 1 to 99 (hour) (1-hour step)
8.8.5	Measurement display	Current, Last
8.8.6	Filter	LP, HP1+LP, HP2+LP, HP+LP, HP'+LP

Bit Rate (bit/s)	HP1	HP2	HP'	HP	LP
2,494.16 M	5 kHz	1 MHz	–	12 kHz	20 MHz
4,988.32 M	8 kHz	2 MHz	–	12 kHz	40 MHz
9,976.64 M	10 kHz	4 MHz	50 kHz	12 kHz	80 MHz

Section	Specification Item	Standard Specification Value

8.8.7 Measuring range



Bit Rate (bit/s)	Range	f0	f3	f4	A2	A3'	A3
2,494.16 M	1 UI	100 Hz	10 MHz	20 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	2.5 MHz	20 MHz	0.5 UIPP	–	4 UIPP
4,988.32 M	1 UI	100 Hz	20 MHz	40 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	5 MHz	40 MHz	0.5 UIPP	–	4 UIPP
9,976.64 M	1 UI	100 Hz	40 MHz	80 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	10 MHz	80 MHz	0.5 UIPP	–	4 UIPP

Section	Specification Item	Standard Specification Value
8.8.8	Accuracy	**[UIPP, UI+p, UI–p]** 1 UI Range: ±5 % ±W UIPP/at 100 kHz 4 UI Range: ±5 % ±W UIPP/at 100 kHz **[UIrms]** 1 UI Range: ±5 % ±Y UIrms/at 100 kHz 4 UI Range: ±5 % ±Y UIrms/at 100 kHz

Bit Rate (bit/s)	W*1		Y*2	
	1 UI Range	4 UI Range	1 UI Range	4 UI Range
2,494.16 M	0.05 UIPP	0.22 UIPP	0.008 UIrms	0.08 UIrms
4,988.32 M	0.07 UIPP	0.24 UIPP	0.009 UIrms	0.09 UIrms
9,976.64 M	0.09 UIPP	0.26 UIPP	0.010 UIrms	0.10 UIrms

NOTE *1:

With HP1+LP

NOTE *2:

With HP+LP

Frequency error (100 kHz set as the reference)

100 Hz to 300 kHz: ±2 %
300 kHz to 1 MHz: ±3 %
1 MHz to 3 MHz: ±5 %
3 MHz to 10 MHz: ±10 %
10 MHz to 80 MHz: ±15 %

8.9	LED display	Unlock, Alarm, Remote
8.9.1	Unlock	Lights up when the Rx section switches into the unlock status.
8.9.2	Alarm	Lights up when the Tx section switches into the abnormal status (such as unlock).
8.9.3	Remote	Lights up when the mode switches into the remote status by the external controller.
8.10	External interface	
8.10.1	GPIB	All the control except for cancellation of remote status enabled from the external controller
8.11	Other	
8.11.1	Dimensions	221.5 High, 426 Wide, 451 Deep (mm)
8.11.2	Weight	23 kg (Max.)
8.11.3	Power source	85 to 132 Vac or 170 to 250 Vac 47.5 to 63 Hz
8.11.4	Temperature	10 to 40 °C, –20 to 60 °C (When stored)

1.2.3 Option 02

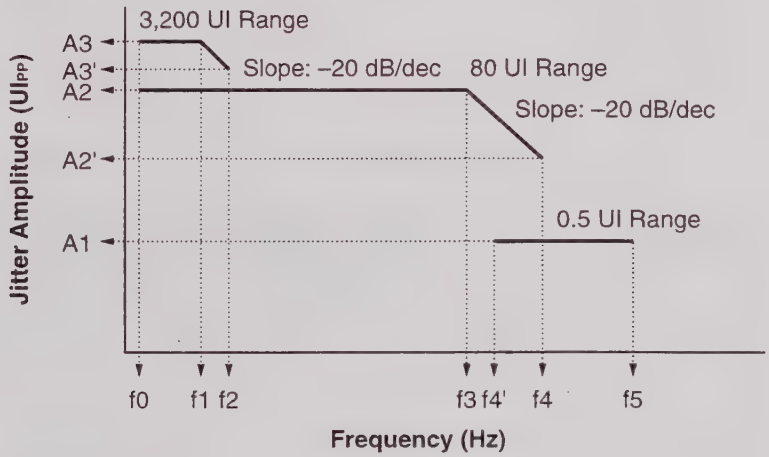
Section	Specification Item	Standard Specification Value
1	Jitter Clock Output	
1.1	Frequency	2,666.0571 MHz, 5,332.1142 MHz, 10,664.2284 MHz
1.2	Termination/Level	50 Ω/+5 dBm ±3 dB
1.3	Connector	APC 3.5 (Clock Output)
2	Jitter Clock Input	
2.1	Frequency	2,666.0571 MHz ±50 ppm, 5,332.1142 MHz ±30 ppm, 10,664.2284 MHz ±20 ppm
2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP} 0.15 V to 1.3 V_{PP} (with Option 10)
2.3	Connector	APC 3.5 (Clock Input)
3	Ext. Ref. Clock Input	
3.1	Frequency	166.62857 MHz
3.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
3.3	Connector	SMA (Clock Input)
4	DCS Input	
4.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
4.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
4.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)

Section	Specification Item	Standard Specification Value		
5	Ext. Mod. Input			
5.1	Frequency range	100 kHz to 80 MHz	(at 0.5 UI Range/10,664.2284 Mbit/s)	
		100 kHz to 40 MHz	(at 0.5 UI Range/5,332.1142 Mbit/s)	
		100 kHz to 20 MHz	(at 0.5 UI Range/2,666.0571 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
5.2	Sensitivity	(0.5 UI Range)		
		0.5 UI_{PP} ±15 %/0.5 V_{PP}	(at 10,664.2284 Mbit/s)	
		0.5 UI_{PP} ±15 %/1 V_{PP}	(at 5,332.1142 Mbit/s)	
		0.5 UI_{PP} ±15 %/2 V_{PP}	(at 2,666.0571 Mbit/s)	
		(3,200 UI, 1,600 UI, 800 UI, 80 UI, 40 UI, 20 UI Range)		
		3,200 Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(10,664.2284 Mbit/s only)
		1,600 Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(5,332.1142 Mbit/s only)
		800 Range:	800 UI_{PP} ±15 %/1 V_{PP}	(2,666.0571 Mbit/s only)
		80 Range:	80 UI_{PP} ±15 %/1 V_{PP}	(10,664.2284 Mbit/s only)
		40 Range:	40 UI_{PP} ±15 %/1 V_{PP}	(5,332.1142 Mbit/s only)
		20 Range:	20 UI_{PP} ±15 %/1 V_{PP}	(2,666.0571 Mbit/s only)
5.3	Termination	50 Ω		
5.4	Connector	BNC (Ext. Mod. Input)		
6	Demod. Output			
6.1	Frequency range	100 Hz to 80 MHz		
6.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range), 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)		
6.3	Termination	50 Ω		
6.4	Tangential line	BNC (Demod. Output)		
7	10M STD Input			
7.1	Frequency range	10 MHz ±50 ppm		
7.2	Level	0 to +10 dBm		
7.3	Termination	50 Ω		
7.4	Connector	BNC		

Section	Specification Item	Standard Specification Value
8		
8.1	**[Clock mode]**	
	CLOCK	Internal, External, Lock 2 MHz (B), Lock 2 MHz (UB), Lock 2 Mbit/s (B), Lock 2 Mbit/s (UB), Lock 1.5 MHz (UB), Lock 1.5 Mbit/s (B), Lock 10 M
8.1.1	Internal Accuracy	Reference signal synchronous with the internal reference signal ±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)
8.1.2	External	Reference signal synchronous with the incoming signal from the Ext. Ref. Clock Input
8.1.2.1	Frequency	166.62857 MHz ±50 ppm
8.1.2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
8.1.2.3	Connector	SMA
8.1.3	DCS Input	Reference signal synchronous with the incoming signal from the DCS Input
8.1.3.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
8.1.3.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
8.1.3.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)
8.1.4	10M STD Input	Reference signal synchronous with the incoming signal from the 10M STD Input
8.1.4.1	Frequency range	10 MHz ±50 ppm
8.1.4.2	Level	0 to +10 dBm
8.1.4.3	Termination	50 Ω
8.1.4.4	Connector	BNC
8.2	**[Variable frequency]**	
8.2.1	Frequency range	±50 ppm
8.2.2	Step	0.1 ppm
8.2.3	Accuracy	±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)

Section	Specification Item	Standard Specification Value		
8.3	**[Jitter generation]**			
8.3.1	Bit Rate	2,666.0571 Mbit/s, 5,332.1142 Mbit/s, 10,664.2284 Mbit/s		
8.4	Jitter modulating signal			
8.4.1	Ext. Mod. Input	Connector for external modulating signal input		
8.4.1.1	Frequency range	100 kHz to 80 MHz	(at 0.5 UI Range/10,664.2284 Mbit/s)	
		100 kHz to 40 MHz	(at 0.5 UI Range/5,332.1142 Mbit/s)	
		100 kHz to 20 MHz	(at 0.5 UI Range/2,666.0571 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
8.4.1.2	Waveform	Sine wave		
8.4.1.3	Sensitivity	3,200 UI Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(10,664.2284 Mbit/s only)
		1,600 UI Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(5,332.1142 Mbit/s only)
		800 UI Range:	800 UI_{PP} ±15 %/1 V_{PP}	(2,666.0571 Mbit/s only)
		80 UI Range:	80 UI_{PP} ±15 %/1 V_{PP}	(10,664.2284 Mbit/s only)
		40 UI Range:	40 UI_{PP} ±15 %/1 V_{PP}	(5,332.1142 Mbit/s only)
		20 UI Range:	20 UI_{PP} ±15 %/1 V_{PP}	(2,666.0571 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/0.5 V_{PP}	(10,664.2284 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/1 V_{PP}	(5,332.1142 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/2 V_{PP}	(2,666.0571 Mbit/s only)
8.4.1.4	Termination	50 Ω		
8.4.1.5	Connector	BNC (Ext. Mod. Input)		
8.4.1.6	Equalizer Amp	Selection of Equalizer Amp. to suit the jitter tolerance mask enabled (10,664.2284 Mbit/s only)		

Section	Specification Item	Standard Specification Value		
8.5	Jitter modulation			
8.5.1	Range	3,200 UI Range:	Up to 3,200 UI_{PP}	(10,664.2284 Mbit/s only)
		1,600 UI Range:	Up to 1,600 UI_{PP}	(5,332.1142 Mbit/s only)
		800 UI Range:	Up to 800 UI_{PP}	(2,666.0571 Mbit/s only)
		80 UI Range:	Up to 80 UI_{PP}	(10,664.2284 Mbit/s only)
		40 UI Range:	Up to 40 UI_{PP}	(5,332.1142 Mbit/s only)
		20 UI Range:	Up to 20 UI_{PP}	(2,666.0571 Mbit/s only)
		0.5 UI Range:	Up to 0.5 UI_{PP}	
8.5.2	Amount of modulation	**[Bit Rate: at 10,664.2284 Mbit/s]**		

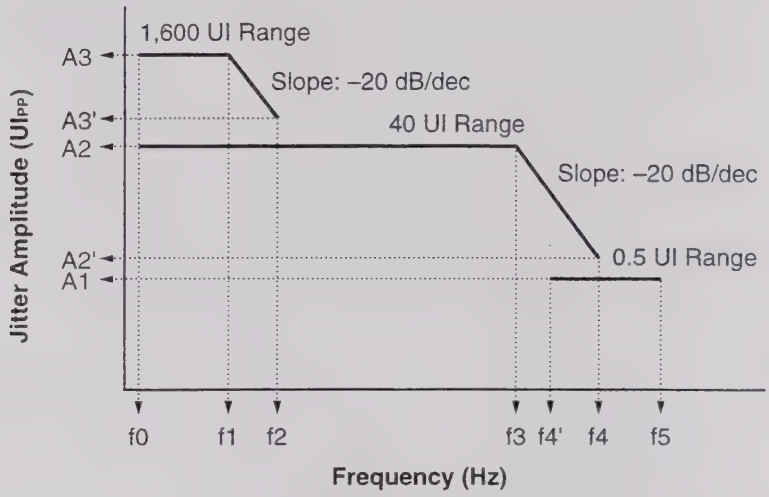


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
10,664.2284 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
80 MHz	0.5 UI_{PP}	4 UI_{PP}	80 UI_{PP}	100 UI_{PP}	3,200 UI_{PP}

Section	Specification Item	Standard Specification Value

[Bit Rate: at 5,332.1142 Mbit/s]

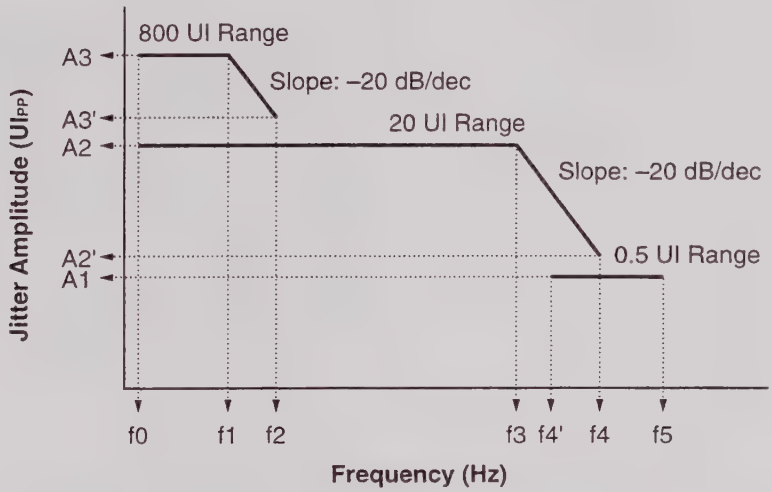


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
5,332.1142 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
40 MHz	0.5 UIPP	2 UIPP	40 UIPP	50 UIPP	1,600 UIPP

Section	Specification Item	Standard Specification Value

[Bit Rate: at 2,666.0571 Mbit/s]



Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
2,666.0571 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
20 MHz	0.5 UI_{PP}	1 UI_{PP}	20 UI_{PP}	25 UI_{PP}	800 UI_{PP}

8.5.3 Accuracy

3,200 UI Range:	±5 % ±10 UI_{PP}/at 10 Hz	(at 10,664.2284 Mbit/s)
1,600 UI Range:	±5 % ± 8 UI_{PP}/at 10 Hz	(at 5,332.1142 Mbit/s)
800 UI Range:	±5 % ± 5 UI_{PP}/at 10 Hz	(at 2,666.0571 Mbit/s)
80 UI Range:	±5 % ±0.8 UI_{PP}/at 100 kHz	(at 10,664.2284 Mbit/s)
40 UI Range:	±5 % ±0.6 UI_{PP}/at 100 kHz	(at 5,332.1142 Mbit/s)
20 UI Range:	±5 % ±0.3 UI_{PP}/at 100 kHz	(at 2,666.0571 Mbit/s)
0.5 UI Range:	±5 % ±0.1 UI_{PP}/at 100 kHz	(at 10,664.2284 Mbit/s)
	±5 % ±0.08 UI_{PP}/at 100 kHz	(at 5,332.1142 Mbit/s)
	±5 % ±0.05 UI_{PP}/at 100 kHz	(at 2,666.0571 Mbit/s)

Frequency error (100 kHz set as the reference)

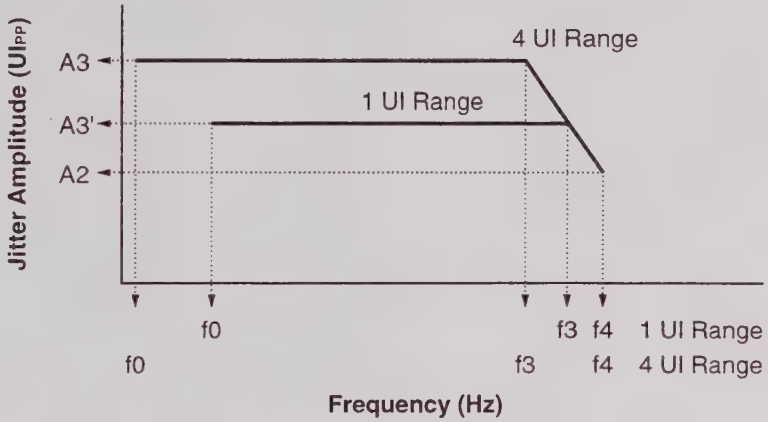
10 Hz to 20 Hz: ±5 %
20 Hz to 300 kHz: ±2 %
300 kHz to 1 MHz: ±3 %
1 MHz to 3 MHz: ±5 %
3 MHz to 10 MHz: ±10 %
10 MHz to 80 MHz: ±15 %

Section	Specification Item	Standard Specification Value
8.6	**[Jitter measurement]** Jitter signal input	
8.6.1	Frequency	2,666.0571 MHz ±50 ppm, 5,332.1142 MHz ±30 ppm, 10,664.2284 MHz ±20 ppm
8.7	Jitter demodulating signal	
8.7.1	Demod. Output	Output of signal demodulated from the incoming signal
8.7.1.1	Frequency range	100 Hz to 80 MHz
8.7.1.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range) 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)
8.7.1.3	Termination	50 Ω
8.7.1.4	Connector	BNC
8.8	Jitter measurement	
8.8.1	Unit	UI_{PP}, UI+p, UI–p, UIrms
8.8.2	Measurement range	1 UI Range (0.000 to 1.010 UI_{PP}/Step 0.001 UI_{PP}) (0.000 to 0.357 UIrms/Step 0.001 UIrms) 4 UI Range (0.00 to 4.04 UI_{PP}/Step 0.01 UI_{PP}) (0.00 to 1.43 UIrms/Step 0.01 UIrms)
8.8.3	Measurement mode	Single, Repeat, Manual
8.8.4	Measurement interval	1 to 99 (second) (1-second step) 1 to 99 (minute) (1-minute step) 1 to 99 (hour) (1-hour step)
8.8.5	Measurement display	Current, Last
8.8.6	Filter	LP, HP1+LP, HP2+LP, HP+LP, HP'+LP

Bit Rate (bit/s)	HP1	HP2	HP'	HP	LP
2,666.0571 M	5 kHz	1 MHz	–	12 kHz	20 MHz
5,332.1142 M	8 kHz	2 MHz	–	12 kHz	40 MHz
10,664.2284 M	10 kHz	4 MHz	50 kHz	12 kHz	80 MHz

Section	Specification Item	Standard Specification Value

8.8.7 Measuring range



Bit Rate (bit/s)	Range	f0	f3	f4	A2	A3'	A3
2,666.0571 M	1 UI	100 Hz	10 MHz	20 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	2.5 MHz	20 MHz	0.5 UIPP	–	4 UIPP
5,332.1142 M	1 UI	100 Hz	20 MHz	40 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	5 MHz	40 MHz	0.5 UIPP	–	4 UIPP
10,664.2284 M	1 UI	100 Hz	40 MHz	80 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	10 MHz	80 MHz	0.5 UIPP	–	4 UIPP

Section	Specification Item	Standard Specification Value
8.8.8	Accuracy	**[UIPP, UI+p, UI–p]** 1 UI Range: ±5 % ±W UIPP/at 100 kHz 4 UI Range: ±5 % ±W UIPP/at 100 kHz **[UIrms]** 1 UI Range: ±5 % ±Y UIrms/at 100 kHz 4 UI Range: ±5 % ±Y UIrms/at 100 kHz

Bit Rate (bit/s)	W*1		Y*2	
	1 UI Range	4 UI Range	1 UI Range	4 UI Range
2,666.0571 M	0.05 UIPP	0.22 UIPP	0.008 UIrms	0.08 UIrms
5,332.1142 M	0.07 UIPP	0.24 UIPP	0.009 UIrms	0.09 UIrms
10,664.2284 M	0.09 UIPP	0.26 UIPP	0.010 UIrms	0.10 UIrms

NOTE *1:

With HP1+LP

NOTE *2:

With HP+LP

Frequency error (100 kHz set as the reference)

100 Hz to 300 kHz: ±2 %
300 kHz to 1 MHz: ±3 %
1 MHz to 3 MHz: ±5 %
3 MHz to 10 MHz: ±10 %
10 MHz to 80 MHz: ±15 %

8.9	LED display	Unlock, Alarm, Remote
8.9.1	Unlock	Lights up when the Rx section switches into the unlock status.
8.9.2	Alram	Lights up when the Tx section switches into the abnormal status (such as unlock).
8.9.3	Remote	Lights up when the mode switches into the remote status by the external controller.
8.10	External interface	
8.10.1	GPIB	All the control except for cancellation of remote status enabled from the external controller
8.11	Other	
8.11.1	Dimensions	221.5 High, 426 Wide, 451 Deep (mm)
8.11.2	Weight	23 kg (Max.)
8.11.3	Power source	85 to 132 Vac or 170 to 250 Vac 47.5 to 63 Hz
8.11.4	Temperature	10 to 40 °C, –20 to 60 °C (When stored)

1.2.4 Option 04

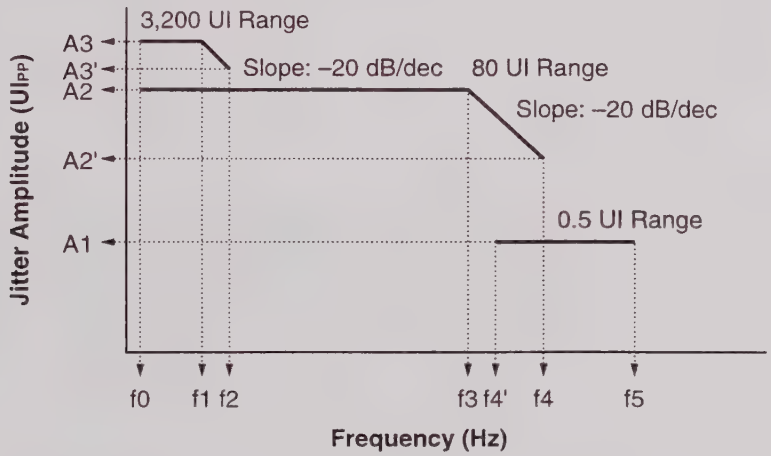
Section	Specification Item	Standard Specification Value
1	Jitter Clock Output	
1.1	Frequency	3,062.3629 MHz, 6,124.7259 MHz, 12,249.4517 MHz
1.2	Termination/Level	50 Ω/+5 dBm ±3 dB
1.3	Connector	APC 3.5 (Clock Output)
2	Jitter Clock Input	
2.1	Frequency	3,062.3629 MHz ±50 ppm, 6,124.7259 MHz ±30 ppm, 12,249.4517 MHz ±20 ppm
2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP} 0.15 V to 1.3 V_{PP} (with Option 10)
2.3	Connector	APC 3.5 (Clock Input)
3	Ext. Ref. Clock Input	
3.1	Frequency	191.39768 MHz
3.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
3.3	Connector	SMA (Clock Input)
4	DCS Input	
4.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
4.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
4.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)

Section	Specification Item	Standard Specification Value		
5	Ext. Mod. Input			
5.1	Frequency range	100 kHz to 80 MHz	(at 0.5 UI Range/12,249.4517 Mbit/s)	
		100 kHz to 40 MHz	(at 0.5 UI Range/6,124.7259 Mbit/s)	
		100 kHz to 20 MHz	(at 0.5 UI Range/3,062.3629 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
5.2	Sensitivity	(0.5 UI Range)		
		0.5 UI_{PP} ±15 %/0.375 V_{PP}	(at 12,249.4517 Mbit/s)	
		0.5 UI_{PP} ±15 %/0.75 V_{PP}	(at 6,124.7259 Mbit/s)	
		0.5 UI_{PP} ±15 %/1.5 V_{PP}	(at 3,062.3629 Mbit/s)	
		(3,200 UI, 1,600 UI, 800 UI, 80 UI, 40 UI, 20 UI Range)		
		3,200 Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(12,249.4517 Mbit/s only)
		1,600 Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(6,124.7259 Mbit/s only)
		800 Range:	800 UI_{PP} ±15 %/1 V_{PP}	(3,062.3629 Mbit/s only)
		80 Range:	80 UI_{PP} ±15 %/1 V_{PP}	(12,249.4517 Mbit/s only)
		40 Range:	40 UI_{PP} ±15 %/1 V_{PP}	(6,124.7259 Mbit/s only)
		20 Range:	20 UI_{PP} ±15 %/1 V_{PP}	(3,062.3629 Mbit/s only)
5.3	Termination	50 Ω		
5.4	Connector	BNC (Ext. Mod. Input)		
6	Demod. Output			
6.1	Frequency range	100 Hz to 80 MHz		
6.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range), 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)		
6.3	Termination	50 Ω		
6.4	Tangential line	BNC (Demod. Output)		
7	10M STD Input			
7.1	Frequency range	10 MHz ±50 ppm		
7.2	Level	0 to +10 dBm		
7.3	Termination	50 Ω		
7.4	Connector	BNC		

Section	Specification Item	Standard Specification Value
8		
8.1	**[Clock mode]**	
	CLOCK	Internal, External, Lock 2 MHz (B), Lock 2 MHz (UB), Lock 2 Mbit/s (B), Lock 2 Mbit/s (UB), Lock 1.5 MHz (UB), Lock 1.5 Mbit/s (B), Lock 10 M
8.1.1	Internal Accuracy	Reference signal synchronous with the internal reference signal ±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)
8.1.2	External	Reference signal synchronous with the incoming signal from the Ext. Ref. Clock Input
8.1.2.1	Frequency	191.39768 MHz ±50 ppm
8.1.2.2	Termination/Level	50 Ω/0.7 V to 1.3 V_{PP}
8.1.2.3	Connector	SMA
8.1.3	DCS Input	Reference signal synchronous with the incoming signal from the DCS Input
8.1.3.1	Frequency/Interface	2.048 Mbit/s ±50 ppm (HDB3) or 2.048 MHz ±50 ppm (CLOCK) 1.544 Mbit/s ±50 ppm (AMI/B8ZS) or 1.544 MHz ±50 ppm (CLOCK)
8.1.3.2	Level	Unbalance: 1.544 MHz, 2.048 MHz (CLOCK); 1.125 V_{0P} ±34 % G.703 2.048 Mbit/s (HDB3); 2.37 V_{0P} ±10 % G.703 Balance: 1.544 Mbit/s, 2.048 Mbit/s; 3.0 V_{0P} ±24 % ANSI T1 102-1987
8.1.3.3	Connector	Unbalance: 75 Ω/BNC Balance: 100 Ω/Weco 310 Compatible (1.544 Mbit/s) 120 Ω/3-Pole CF (2.048 Mbit/s)
8.1.4	10M STD Input	Reference signal synchronous with the incoming signal from the 10M STD Input
8.1.4.1	Frequency range	10 MHz ±50 ppm
8.1.4.2	Level	0 to +10 dBm
8.1.4.3	Termination	50 Ω
8.1.4.4	Connector	BNC
8.2	**[Variable frequency]**	
8.2.1	Frequency range	±50 ppm
8.2.2	Step	0.1 ppm
8.2.3	Accuracy	±0.1 ppm (at 23 ±5 °C following calibration performed 60 minutes after the power is turned ON)

Section	Specification Item	Standard Specification Value		
8.3	**[Jitter generation]**			
8.3.1	Bit Rate	3,062.3629 Mbit/s, 6,124.7259 Mbit/s, 12,249.4517 Mbit/s		
8.4	Jitter modulating signal			
8.4.1	Ext. Mod. Input	Connector for external modulating signal input		
8.4.1.1	Frequency range	100 kHz to 80 MHz	(at 0.5 UI Range/12,249.4517 Mbit/s)	
		100 kHz to 40 MHz	(at 0.5 UI Range/6,124.7259 Mbit/s)	
		100 kHz to 20 MHz	(at 0.5 UI Range/3,062.3629 Mbit/s)	
		10 Hz to 2 MHz	(80 UI, 40 UI, 20 UI Range)	
		10 Hz to 480 Hz	(3,200 UI, 1,600 UI, 800 UI Range)	
8.4.1.2	Waveform	Sine wave		
8.4.1.3	Sensitivity	3,200 UI Range:	3,200 UI_{PP} ±15 %/1 V_{PP}	(12,249.4517 Mbit/s only)
		1,600 UI Range:	1,600 UI_{PP} ±15 %/1 V_{PP}	(6,124.7259 Mbit/s only)
		800 UI Range:	800 UI_{PP} ±15 %/1 V_{PP}	(3,062.3629 Mbit/s only)
		80 UI Range:	80 UI_{PP} ±15 %/1 V_{PP}	(12,249.4517 Mbit/s only)
		40 UI Range:	40 UI_{PP} ±15 %/1 V_{PP}	(6,124.7259 Mbit/s only)
		20 UI Range:	20 UI_{PP} ±15 %/1 V_{PP}	(3,062.3629 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/0.375 V_{PP}	(12,249.4517 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/0.75 V_{PP}	(6,124.7259 Mbit/s only)
		0.5 UI Range:	0.5 UI_{PP} ±15 %/1.5 V_{PP}	(3,062.3629 Mbit/s only)
8.4.1.4	Termination	50 Ω		
8.4.1.5	Connector	BNC (Ext. Mod. Input)		
8.4.1.6	Equalizer Amp	Selection of Equalizer Amp. to suit the jitter tolerance mask enabled (12,249.4517 Mbit/s only)		

Section	Specification Item	Standard Specification Value		
8.5	Jitter modulation			
8.5.1	Range	3,200 UI Range:	Up to 3,200 UI_{PP}	(12,249.4517 Mbit/s only)
		1,600 UI Range:	Up to 1,600 UI_{PP}	(6,124.7259 Mbit/s only)
		800 UI Range:	Up to 800 UI_{PP}	(3,062.3629 Mbit/s only)
		80 UI Range:	Up to 80 UI_{PP}	(12,249.4517 Mbit/s only)
		40 UI Range:	Up to 40 UI_{PP}	(6,124.7259 Mbit/s only)
		20 UI Range:	Up to 20 UI_{PP}	(3,062.3629 Mbit/s only)
		0.5 UI Range:	Up to 0.5 UI_{PP}	
8.5.2	Amount of modulation	**[Bit Rate: at 12,249.4517 Mbit/s]**		

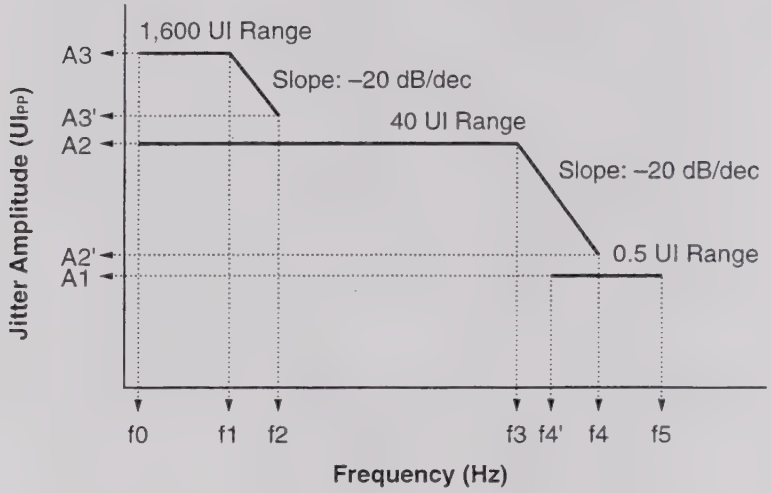


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
12,249.4517 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
80 MHz	0.5 UI_{PP}	4 UI_{PP}	80 UI_{PP}	100 UI_{PP}	3,200 UI_{PP}

Section	Specification Item	Standard Specification Value

[Bit Rate: at 6,124.7259 Mbit/s]

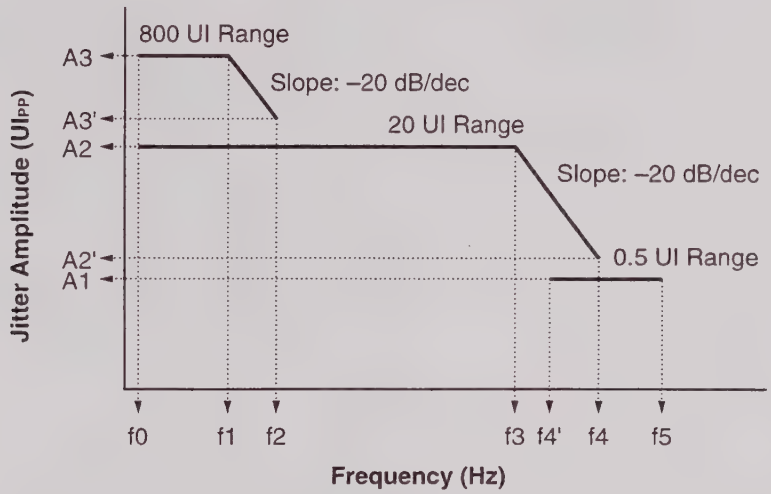


Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
6,124.7259 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
40 MHz	0.5 UI_{PP}	2 UI_{PP}	40 UI_{PP}	50 UI_{PP}	1.600 UI_{PP}

Section	Specification Item	Standard Specification Value

[Bit Rate: at 3,062.3629 Mbit/s]



Bit Rate (bit/s)	f0	f1	f2	f3	f4	f4'
3,062.3629 M	10 Hz	15 Hz	480 Hz	100 kHz	2 MHz	100 kHz

f5	A1	A2'	A2	A3'	A3
20 MHz	0.5 UIPP	1 UIPP	20 UIPP	25 UIPP	800 UIPP

8.5.3 Accuracy

3,200 UI Range:	±5 % ±10 UIPP/at 10 Hz	(at 12,249.4517 Mbit/s)
1,600 UI Range:	±5 % ± 8 UIPP/at 10 Hz	(at 6,124.7259 Mbit/s)
800 UI Range:	±5 % ± 5 UIPP/at 10 Hz	(at 3,062.3629 Mbit/s)
80 UI Range:	±5 % ±0.8 UIPP/at 100 kHz	(at 12,249.4517 Mbit/s)
40 UI Range:	±5 % ±0.6 UIPP/at 100 kHz	(at 6,124.7259 Mbit/s)
20 UI Range:	±5 % ±0.3 UIPP/at 100 kHz	(at 3,062.3629 Mbit/s)
0.5 UI Range:	±5 % ±0.1 UIPP/at 100 kHz	(at 12,249.4517 Mbit/s)
	±5 % ±0.08 UIPP/at 100 kHz	(at 6,124.7259 Mbit/s)
	±5 % ±0.05 UIPP/at 100 kHz	(at 3,062.3629 Mbit/s)

Frequency error (100 kHz set as the reference)

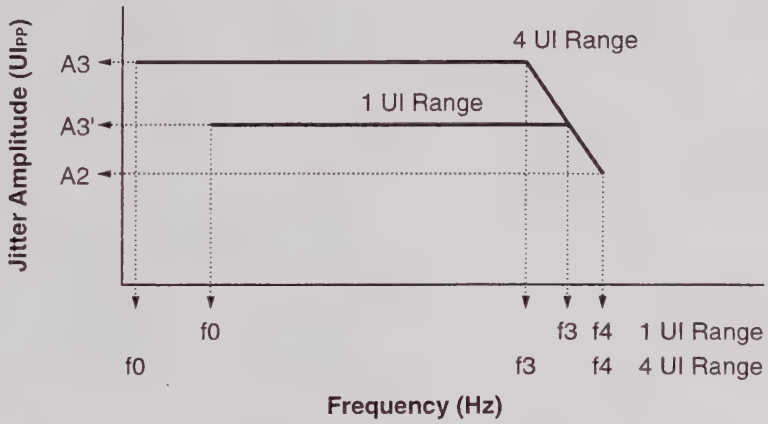
10 Hz to 20 Hz:	±5 %
20 Hz to 300 kHz:	±2 %
300 kHz to 1 MHz:	±3 %
1 MHz to 3 MHz:	±5 %
3 MHz to 10 MHz:	±10 %
10 MHz to 80 MHz:	±15 %

Section	Specification Item	Standard Specification Value
8.6	**[Jitter measurement]** Jitter signal input	
8.6.1	Frequency	3,062.3629 MHz ±50 ppm, 6,124.7259 MHz ±30 ppm, 12,249.4517 MHz ±20 ppm
8.7	Jitter demodulating signal	
8.7.1	Demod. Output	Output of signal demodulated from the incoming signal
8.7.1.1	Frequency range	100 Hz to 80 MHz
8.7.1.2	Sensitivity	1 V_{PP} ±15 %/1 UI_{PP} (1 UI Range) 1 V_{PP} ±15 %/4 UI_{PP} (4 UI Range)
8.7.1.3	Termination	50 Ω
8.7.1.4	Connector	BNC
8.8	Jitter measurement	
8.8.1	Unit	UI_{PP}, UI+p, UI–p, UIrms
8.8.2	Measurement range	1 UI Range (0.000 to 1.010 UI_{PP}/Step 0.001 UI_{PP}) (0.000 to 0.357 UIrms/Step 0.001 UIrms) 4 UI Range (0.00 to 4.04 UI_{PP}/Step 0.01 UI_{PP}) (0.00 to 1.43 UIrms/Step 0.01 UIrms)
8.8.3	Measurement mode	Single, Repeat, Manual
8.8.4	Measurement interval	1 to 99 (second) (1-second step) 1 to 99 (minute) (1-minute step) 1 to 99 (hour) (1-hour step)
8.8.5	Measurement display	Current, Last
8.8.6	Filter	LP, HP1+LP, HP2+LP, HP+LP, HP'+LP

Bit Rate (bit/s)	HP1	HP2	HP'	HP	LP
3,062.3629 M	5 kHz	1 MHz	–	12 kHz	20 MHz
6,124.7259 M	8 kHz	2 MHz	–	12 kHz	40 MHz
12.249.4517 M	10 kHz	4 MHz	50 kHz	12 kHz	80 MHz

Section	Specification Item	Standard Specification Value

8.8.7 Measuring range



Bit Rate (bit/s)	Range	f0	f3	f4	A2	A3'	A3
3,062.3629 M	1 UI	100 Hz	10 MHz	20 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	2.5 MHz	20 MHz	0.5 UIPP	–	4 UIPP
6,124.7259 M	1 UI	100 Hz	20 MHz	40 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	5 MHz	40 MHz	0.5 UIPP	–	4 UIPP
12,249.4517 M	1 UI	100 Hz	40 MHz	80 MHz	0.5 UIPP	1 UIPP	–
	4 UI	100 Hz	10 MHz	80 MHz	0.5 UIPP	–	4 UIPP

Section	Specification Item	Standard Specification Value
8.8.8	Accuracy	**[UIPP, UI+p, UI–p]** 1 UI Range: ±5 % ±W UIPP/at 100 kHz 4 UI Range: ±5 % ±W UIPP/at 100 kHz **[UIrms]** 1 UI Range: ±5 % ±Y UIrms/at 100 kHz 4 UI Range: ±5 % ±Y UIrms/at 100 kHz

Bit Rate (bit/s)	W*1		Y*2	
	1 UI Range	4 UI Range	1 UI Range	4 UI Range
3,062.3629 M	0.05 UIPP	0.22 UIPP	0.008 UIrms	0.08 UIrms
6,124.7259 M	0.07 UIPP	0.24 UIPP	0.009 UIrms	0.09 UIrms
12,249.4517 M	0.09 UIPP	0.26 UIPP	0.010 UIrms	0.10 UIrms

NOTE *1:

With HP1+LP

NOTE *2:

With HP+LP

Frequency error (100 kHz set as the reference)

100 Hz to 300 kHz: ±2 %
300 kHz to 1 MHz: ±3 %
1 MHz to 3 MHz: ±5 %
3 MHz to 10 MHz: ±10 %
10 MHz to 80 MHz: ±15 %

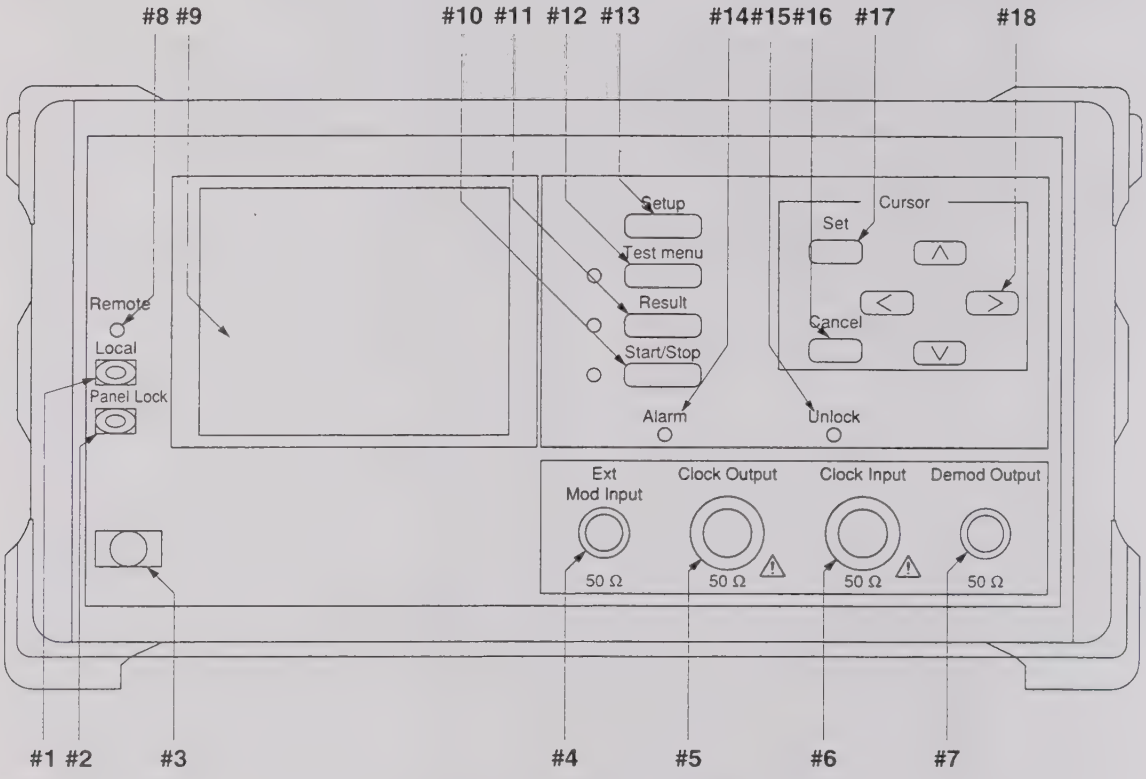
8.9	LED display	Unlock, Alarm, Remote
8.9.1	Unlock	Lights up when the Rx section switches into the unlock status.
8.9.2	Alram	Lights up when the Tx section switches into the abnormal status (such as unlock).
8.9.3	Remote	Lights up when the mode switches into the remote status by the external controller.
8.10	External interface	
8.10.1	GPIB	All the control except for cancellation of remote status enabled from the external controller
8.11	Other	
8.11.1	Dimensions	221.5 High, 426 Wide, 451 Deep (mm)
8.11.2	Weight	23 kg (Max.)
8.11.3	Power source	85 to 132 Vac or 170 to 250 Vac 47.5 to 63 Hz
8.11.4	Temperature	10 to 40 °C, –20 to 60 °C (When stored)

Section 2 Description of Panel

2.1 Description of Main Unit Panel 2-2
2.1.1 Front Panel 2-2
2.1.2 Back Panel 2-4

2.1 Description of Main Unit Panel

2.1.1 Front Panel

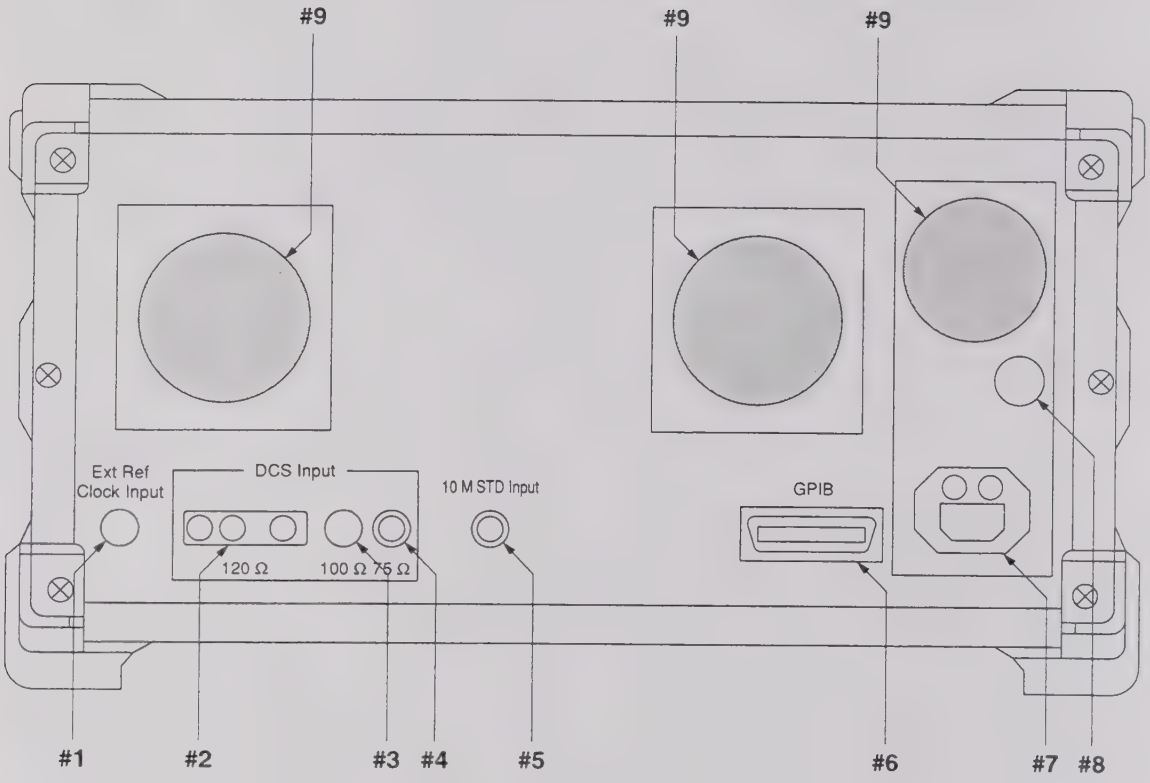


Description of the Front Panel

No.	Label	Description
#1	Local	Switches this device into the local control status (state where the panel key is effective) by an effective key when the remote lamp is lit. This does not operate when the remote lamp is unlit.
#2	Panel Lock	Switches keys other than the panel lock and local keys between the status of input enabled and the status of input disabled. When the LED is ON, input of keys other than panel lock and local keys is disabled.
#3	Power switch	A switch to turn the AC power source ON and OFF.
#4	Ext. Mod. Input	Inputs external modulating signal to the BNC connector.
#5	Clock Out	Connector for clock output. Level: +4 dBm ±3 dB Connector: APC 3.5/50 Ω

No.	Label	Description
#6	Clock Input	Connector for clock input Level: 0.7 to 1.3 V_{PP} 0.15 V to 1.3 V_{PP} (with Option 10) Connector: APC 3.5/50 Ω
#7	Demod. Out	Connector to output the demodulation signal.
#8	Remote	Lights up when this device is in the remote status (status controlled by GPIB)
#9	(Display screen)	A screen to display the measurement items, setup items and measured results.
#10	Start/Stop	Starts and stops measurement.
#11	Result	Displays the Result screen. Closes the Result screen when it is already displayed. Does not operate when the window is open. Does not operate either when the Result window alone is displayed. Indicates "Result Screen Currently being Displayed" when the LED is ON.
#12	Test Menu	Displays the Test Menu screen. Closes the Test Menu screen when it is already displayed. Does not operate when the window is open. Does not operate either when the Test Menu window alone is displayed. Indicates "Test Menu Screen Currently being Displayed" when the LED is ON.
#13	Setup	Displays the Setup screen. Closes the Setup screen when it is already displayed. Does not operate when the window is open. Does not operate either when the Setup window alone is displayed. Indicates "Setup Screen Currently Displayed" when the LED is ON.
#14	Alarm	The lamp lights up when the jitter transmission module is in the state of Unlock.
#15	Unlock	The Unlock lamp lights up when the jitter reception module is in the state of Unlock.
#16	Cancel	Selected at the time of data setting to close the window. The data being set in the window become invalid (setting before opening of the window will be maintained). Does not operate when the window is closed.
#17	Set	Selected at the time of data setting to open the window. Sets the item on the black and white reversed cursor when the window is already open.
#18	<∧∨>	Moves the cursor and window cursor on the screen. Increases or decreases the numerical value by using the ∧ and ∨ in the window of numerical value input. These keys operate continuously by holding them down.

2.1.2 Back Panel



Description of the Back Panel

No.	Label	Description
#1	Ext Ref Clock Input	Connector for external reference signal input.
#2	DCS Input 120 Ω	Connector for synchronization with the external signal. Input clock that conforms to ITU-T.G.703-10 or HDB3 data.
#3	DCS Input 100 Ω	Connector for synchronization with the external clock. Input HDB3, AMI, or B8ZS data that conforms to ANSI T1.
#4	DCS Input 75 Ω	Connector for synchronization with the external clock. Input clock that conforms to ITU-T.G.703-10 or HDB3 data.
#5	10M STD Input	Connector to input 10 MHz signal from the external equipment at the time of Clock = Lock 10 M.
#6	GPIB	A GPIB interface connector.
#7	[Tangential line for AC power source]	A tangential line for AC power source. Make sure to use the power source cord that comes with the device.
#8	[Frame grounding terminal]	A frame grounding terminal. Make sure to connect it to the ground potential before the power is supplied to use a bipolar power receptacle.
#9	Cooling fan	A fan for cooling purpose. Do not block this face.

Section 3 Basic Operations

3.1 Screen Structure 3-2
3.2 Segmented Display of Screen 3-3
3.3 Selection of Screen 3-4
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3.4.3 Setting by Numerical Value 3-7
3.4.4 Setting by Character 3-8
3.5 Starting/Stopping Measurement 3-10

3.1 Screen Structure

The MP1777A screen is configured as follows.

Main screen name	Secondary screen name	Detail of screen contents
Setup	Interface	Performs setting for the interface, clock source, equalizer and other.
	Memory	Performs setting for the memory and other.
	System	Performs setting for the buzzer, clock, GPIB and other.
Test menu	Manual Jitter	Performs setting for Tx, Rx, frequency offset and other.
Result	Jitter	Performs setting for the style of display data, mode of measured result display and other.

3.2 Segmented Display of Screen

The MP1777A enables the Main screen shown below to be displayed at the same time.

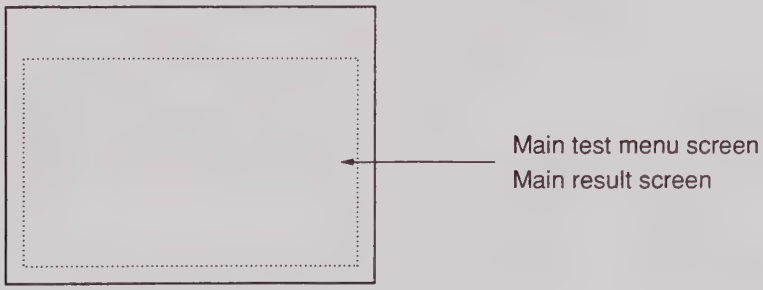
(1) Main test menu screen

(2) Main result screen

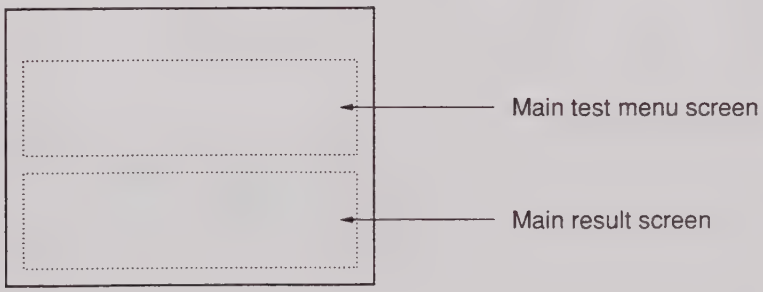
The combination of these screens is shown on segmented display. The Main setup screen cannot be displayed together with other screens.

Switch the screen layout from (1) to (2).

(1) Single segment display



(2) Display segmented into two



3.3 Selection of Screen

This section provides explanations of the method of selection of the MP1777A screen.

(1) Selection of the Main screen

The Main screen can be selected by using the setup, test menu or result key.

Key name	Description
Setup	Pressing this key once causes the screen to move to the Main setup screen. Pressing this key again causes the screen to return to the screen shown before the move.
Test menu	Pressing this key once causes the LED located to the left of the key to light up. Pressing the key again causes the same LED to light off. • When LED is lit: Shows that the Main test menu screen is displayed. • When LED is unlit: Shows that the Main test menu screen is no displayed.
Result	Pressing this key once causes the LED located to the left of the key to light up. Pressing the key again causes the same LED to light off. • When LED is lit: Shows that the Main result screen is displayed. • When LED is unlit: Shows that the Main result screen is no displayed.

NOTE:

When the LED located to the left of the test menu key and the result key are lit at the same time, it signifies that the Main screens for these are displayed at the same time. (Segmented display)

(2) Selection of the secondary screen

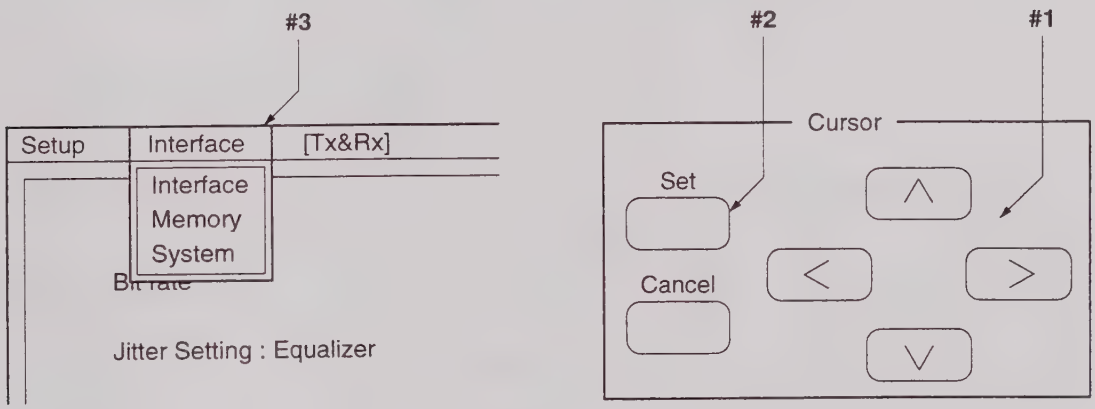
Move the cursor to the area for switching to the secondary screen (located to the right of the main screen name) on each screen and press the Set key. As the window for item selection is displayed, select a secondary screen of your choice from the window. Pressing the Set key again causes the window for item selection to close and the specified secondary screen to be displayed.

3.4 Setting of Measurement Conditions

3.4.1 Basic Operation of Setting

Basically follow procedures set out below in order to modify items for the MP1777A.

(1) Press the cursor key (#1) and move the cursor onto the item you wish to modify.
(2) Press the Set (#2) key.
(3) As the window for item modification opens, set the target item in accordance with the explanations given in 3.4.2. (#3)
(4) When the window for item modification closes, the modified details are set.



NOTE:

Pressing the Cancel key causes the setting to return to the original setting if you wish to cancel setting operations.
Windows for some of the items you wish to modify may not open.

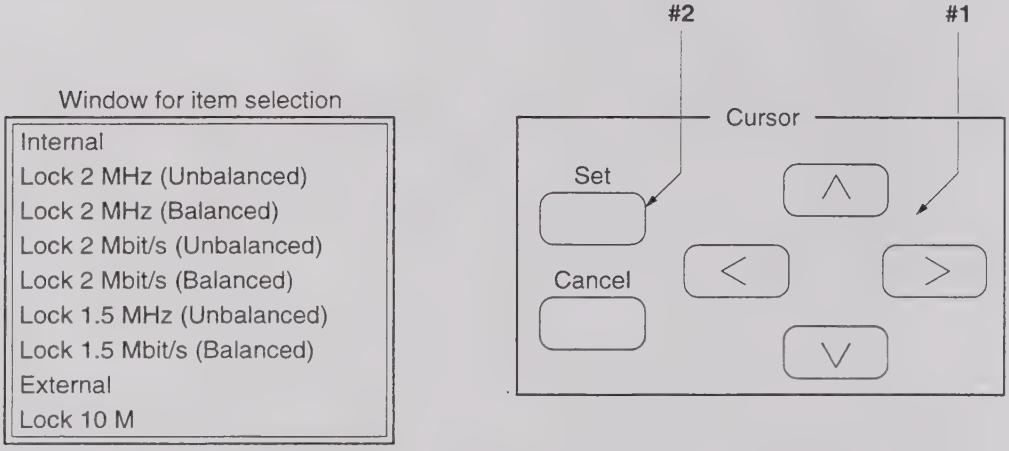
3.4.2 Setting by Item

To perform setting by item selection, the window for item selection opens.
This section provides operation procedures in the window for item selection.

(1) Press the cursor key (#1) and move the cursor onto the item of your choice.
(2) Press the Set (#2) key.
(3) The window for item selection automatically closes.

NOTE:

A window for Yes or No selection for confirmation purposes may open for certain items selected. In this case, check the item selected and press the Set key pointed to Yes to set the item or the same key pointed to No to cancel the item. The cancel key can also be used to cancel the item setting.

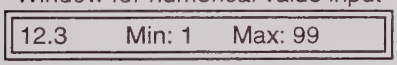


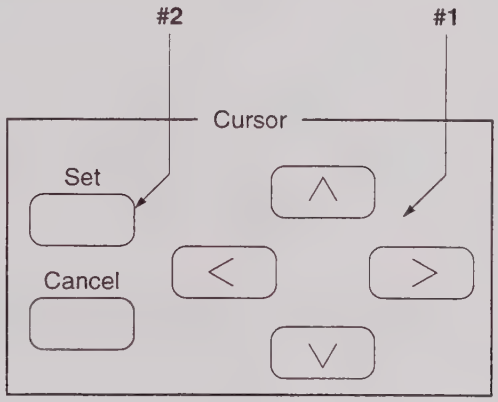
3.4.3 Setting by Numerical Value

To perform setting by numerical value input, the window for numerical value input opens.
This section provides operation procedures in the window for numerical value input.

(1) Press the cursor key (← or → of #1) and move the cursor onto the digit of your choice.
(2) Press the cursor key (↑ or ↓ of #1) and modify the value.
(3) Repeat operations, (1) and (2), until the value in the window reaches the numerical value intended.
(4) Press the Set (#2) key.
(5) The window for numerical value input automatically closes.

Window for numerical value input

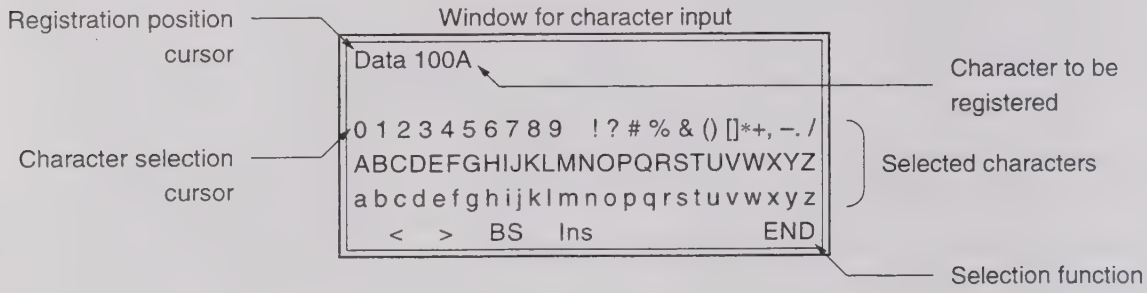


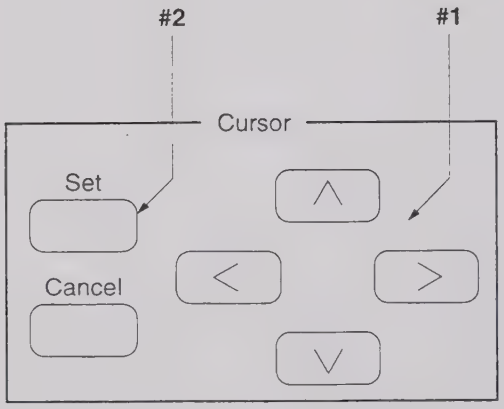


3.4.4 Setting by Character

To perform setting by character input, the window for character input opens. This section provides operation procedures in the window for character input.

(1) Press the cursor key (#1) and move the character selection cursor onto < or >.
(2) Press the Set (#2) key and move the registration position cursor.
(3) Press the cursor key (#1) and move the character selection cursor onto the character of your choice
(4) Press the Set (#2) key and input characters.
(5) Repeat operations, (3) and (4), until the character string to be registered becomes the character string intended.
(6) When the input of the character string is completed, press the cursor key (#1) and move the character selection cursor onto END.
(7) Press the Set key.
(8) The window for character input automatically closes.

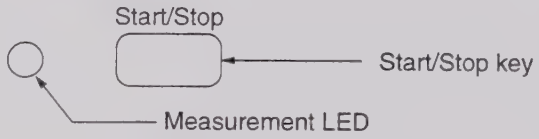

Registration position cursor
Window for character input
Data 100A
Character to be registered
0 1 2 3 4 5 6 7 8 9 ! ? # % & () []*+, –. /
ABCDEFGHIJKLMNOPQRSTUVWXYZ
a b c d e f g h i j k l m n o p q r s t u v w x y z
Character selection cursor
Selected characters
< > BS Ins END
Selection function



Function character for selection	Operations
<	Moves the registration position cursor to the top left. Moves the same cursor to the left edge when it is located at the left edge of the registration character area.
>	Moves the registration position cursor to the right. Moves the same cursor to the left edge when it is located at the right edge of the registration character area.
BS	Deletes a character located to the left of the registration position cursor and moves the character string that comes from after the registration position cursor by one character worth to the left. Does not operate when the registration position cursor is located at the left edge of the registration character area.
Ins	Moves the character string located from after the registration position cursor to the right by one character worth and insert a blank space equivalent to a character at the position of the registration position cursor. The registration character string comprises up to fifteen characters and any excess character will be deleted.
END	Sets the character string to be registered and closes the character string window.

3.5 Starting/Stopping Measurement

Basically, use the Start/Stop key to start/stop the measurement on the MP1777A. The Start/Stop LED indicates the measurement status: When the LED is ON, it indicates that the MP1777A is measuring. When the LED is OFF, you can click the Start/Stop key to start the measurement. When the LED is ON, you can click the Start/Stop key to stop the measurement.



Notes:

1. Measurement starts in the following cases in addition to the case when clicking the Start/Stop key at LED-OFF.
   - With repeat measurement set, a new round of measurement has started.
   - Setting conditions related to measurement are modified during measurement.

2. Measurement stops in the following cases in addition to the case when clicking the Start/Stop key at LED-ON.
   - With a measurement cycle set, the measurement cycle set comes to an end after the measurement starts. (In the case of repeat measurement, the next round of measurement starts immediately after the previous round of measurement ends.)
   - Setting conditions related to measurement are modified during measurement. (The next round of measurement starts immediately after the previous round of measurement ends.)

Section 4 Description of Each Screen

4.1 Main Setup Screen 4-2
4.1.1 Secondary Interface Screen 4-2
4.1.2 Secondary Memory Screen 4-5
4.1.3 Secondary System Screen 4-6
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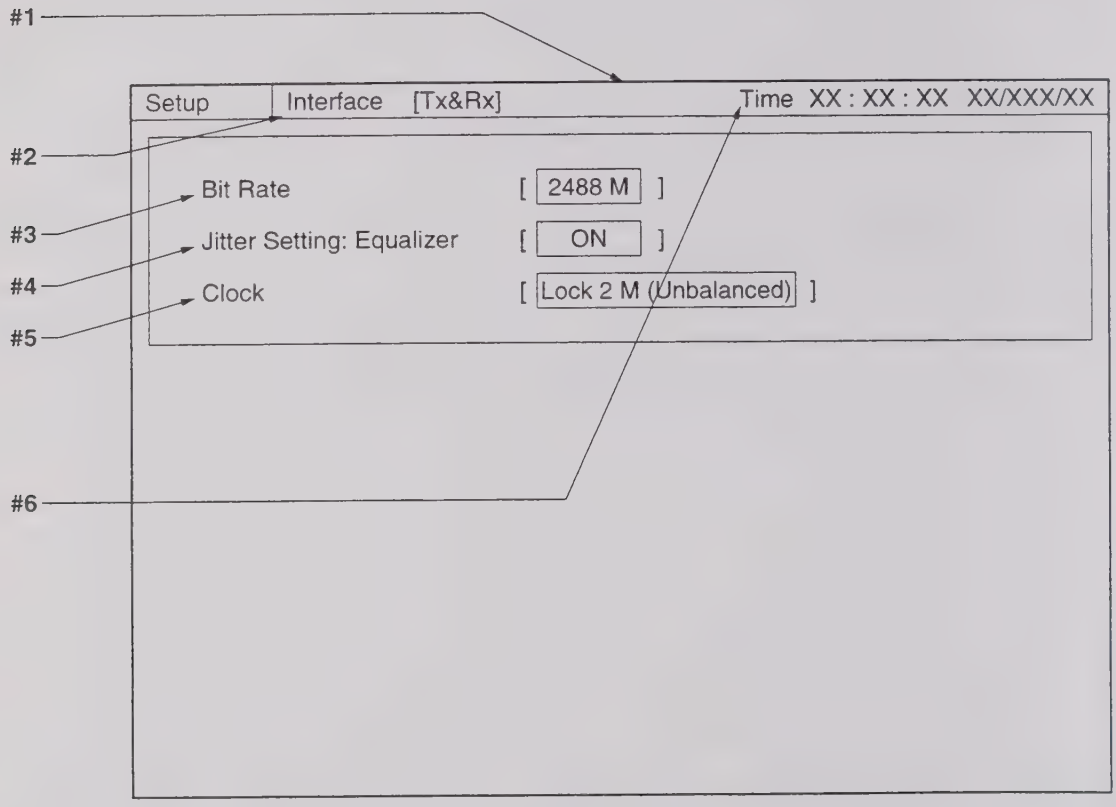
4.3.1 Secondary Jitter Screen 4-8

4.1 Main Setup Screen

4.1.1 Secondary Interface Screen

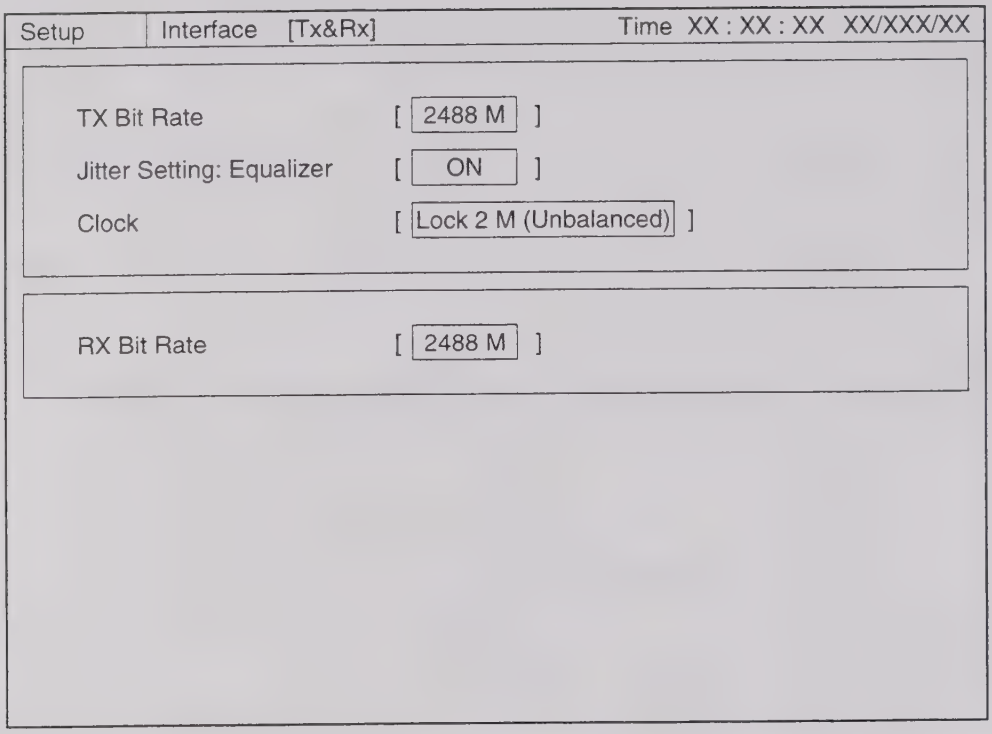
(1) Interface (Tx&Rx)

A screen to establish default setting of measurement. When modifications are added to the screen in the process of measurement, the measurement starts again. A method is available to establish setting separately for transmission and reception as Tx/Rx.



No.	Display	Description
#1	[Secondary screen selection]	Selects a secondary screen of the Main setup screen. A secondary screen must be selected at this position also with other screens.
#2		Enables selection of the setting method. Tx&Rx: Enables the same setting for transmission and reception. The value set for Rx will be set as the bit rate when the mode is switched from Tx/Rx to Tx&Rx. Tx/Rx: Enables setting separately for transmission and reception.
#3	Bit Rate	Clock Sets the Tx and Rx bit rate. When Option is not mounted, the following bit rate can be set. 2,488 Mbit/s, 4,977 Mbit/s, 9,953 Mbit/s When Option 01 is mounted, the following bit rate can be set. 2,494 Mbit/s, 4,988 Mbit/s, 9,977 Mbit/s When Option 02 is mounted, the following bit rate can be set. 2,666 Mbit/s, 5,332 Mbit/s, 10,664 Mbit/s When Option 04 is mounted, the following bit rate can be set. 3,062 Mbit/s, 6,125 Mbit/s, 12,249 Mbit/s
#4	Jitter Setting: Equalizer	Sets the equalizer ON and OFF. (Enabled only when 9,953 Mbit/s, 9,977 Mbit/s, 10,664 Mbit/s and 12,249 Mbit/s are selected.) ON: The Ext. Mod. Input sensitivity changes linked to the tolerance mask. OFF: The Ext. Mod. Input sensitivity becomes fixed.
#5	Clock	Sets the clock source. Internal: Internal self-oscillation. Lock 2 MHz (Balanced): Clock synchronous with the 2 MHz signal input from the external DCS Input (120 Ω) Lock 2 MHz (Unbalanced): Clock synchronous with the 2 MHz signal input from the external DCS Input (75 Ω) Lock 2 Mbit/s (Balanced): Clock synchronous with the 2 Mbit/s signal input from the external DCS Input (120 Ω) Lock 2 Mbit/s (Unbalanced): Clock synchronous with the 2 Mbit/s signal input from the external DCS Input (75 Ω) Lock 1.5 Mbit/s (Balanced): Clock synchronous with the 1.5 Mbit/s signal input from the external DCS Input (100 Ω) Lock 1.5 MHz (Unbalanced): Clock synchronous with the 1.5 MHz signal input from the external DCS Input (75 Ω) External: Clock synchronous with the signal input from the Ext. Ref. Clock Input. Lock 10 M: Clock synchronous with the 10 MHz signal input from the 10 M STD Input
#6	Time	Displays the current date and time.

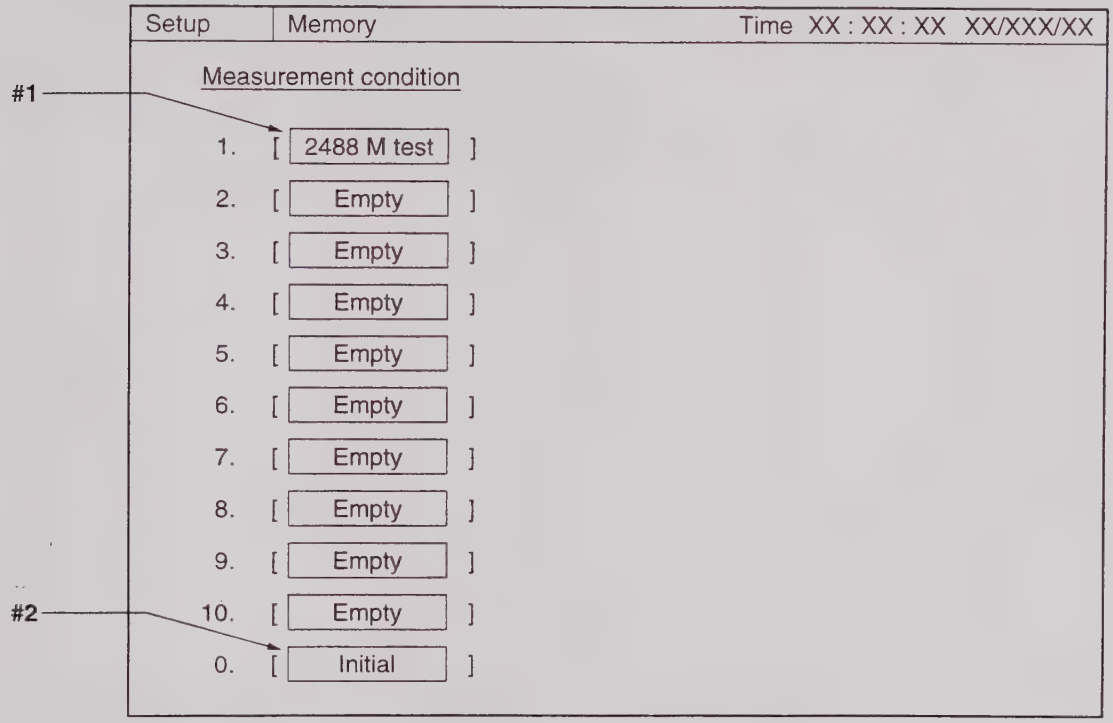
(2) Interface (Tx/Rx)


Setup
Interface [Tx&Rx]
Time XX : XX : XX XX/XXX/XX
TX Bit Rate [2488 M]
Jitter Setting: Equalizer [ON]
Clock [Lock 2 M (Unbalanced)]
RX Bit Rate [2488 M]

Setting for transmission is performed in the upper half of the screen, while setting for reception is performed in the bottom half of the screen. The details of the display are the same as those for Tx&Rx.

4.1.2 Secondary Memory Screen

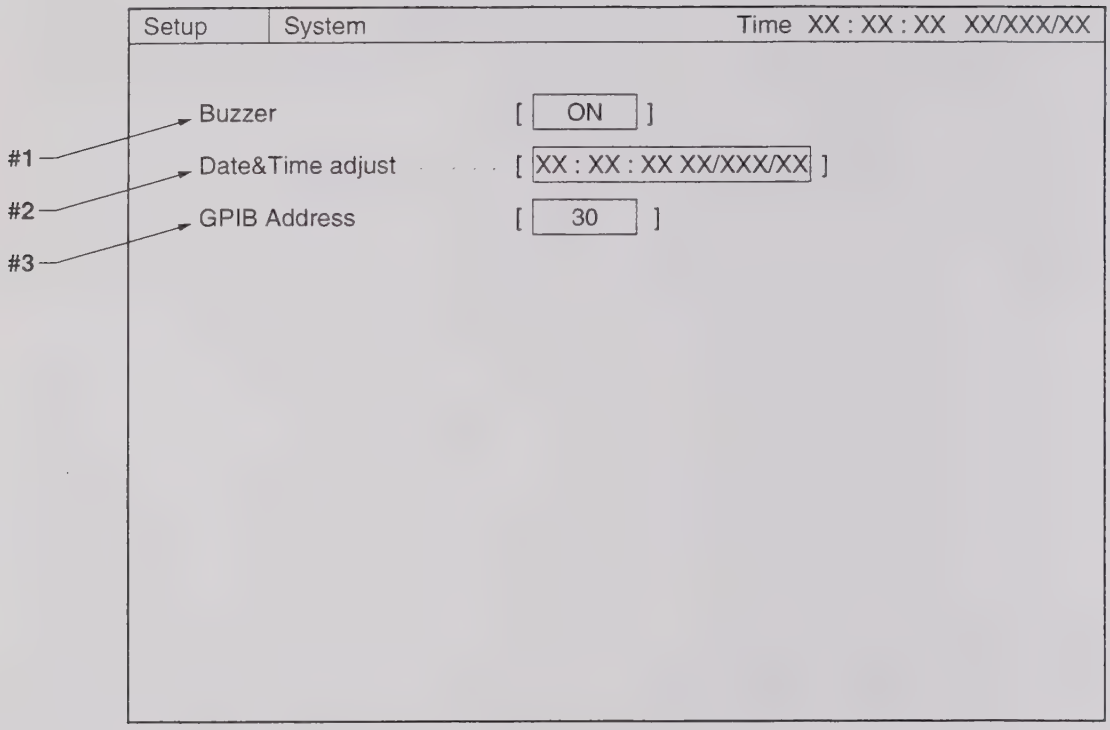
The MP1777A can internally store setting conditions. This screen is used to store and read setting conditions. Memory can be maintained even when the power is turned OFF.



No.	Display	Description
#1	Measurement Condition 1-10	Memory to store measurement conditions. Registration of up to ten measurement conditions enabled. Pressing the Set key causes the window for item selection to open. Here, saving, overwriting, reading and deleting data, and changing names are enabled. To save data or change names, the window for character input further opens to enable input of names. When memory is empty, the name "Empty" is displayed.
#2	Measurement Condition 0	A special memory storing default values. Used to return measurement conditions to initial values. This memory cannot be used for operations other than reading.

4.1.3 Secondary System Screen

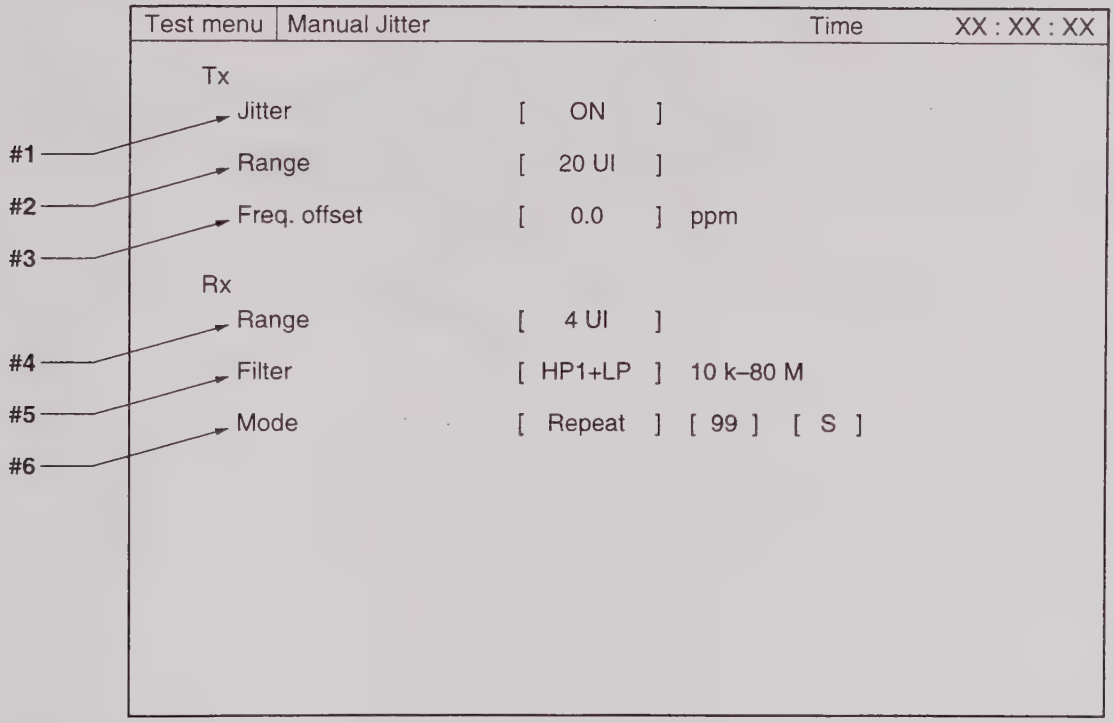
A screen used to perform basic MP1777A setting. This screen is also used to establish setting for GPIB.



No.	Display	Description
#1	Buzzer	Enables selection of whether or not to blow buzzer when alarm or unlock is generated or the setting is wrong.
#2	Date&Time adjust	Sets the clock built in the MP1777A. Pressing the Set key causes the window for numerical value input to open to enable setting of the time.
#3	GPIB Address	Enables setting of the primary address of GPIB within the range between 0 and 30.

4.2 Main Test Menu Screen

4.2.1 Secondary Manual Screen



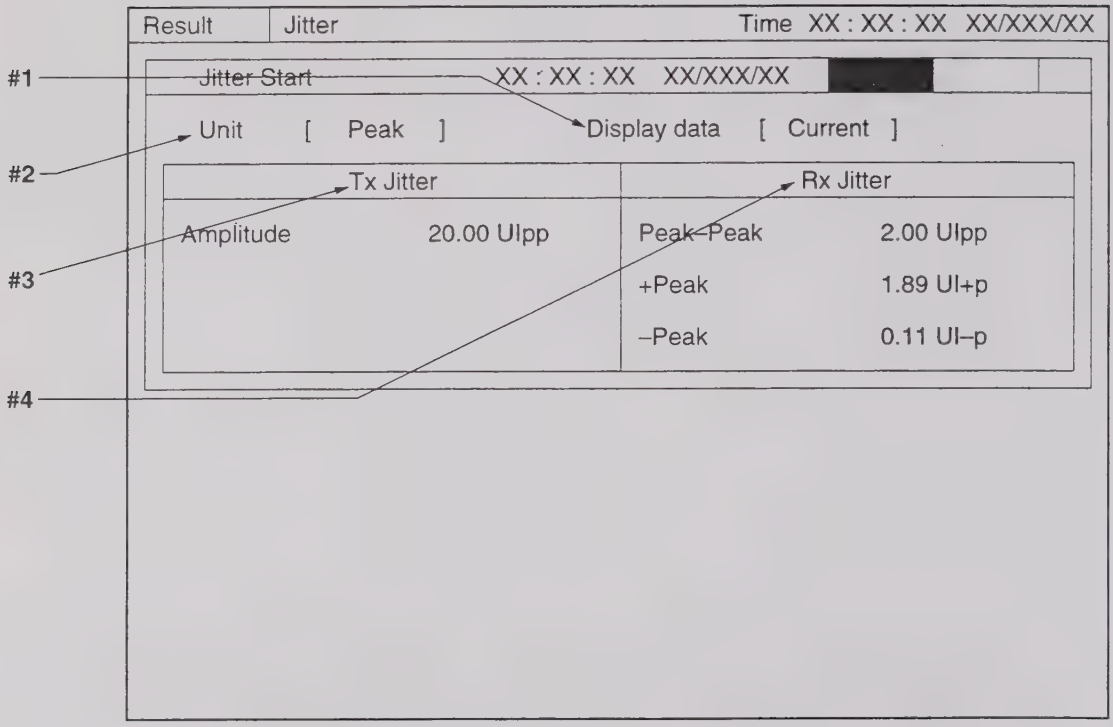
No.	Display	Description
#1	Tx Jitter	Sets jitter generation ON and OFF. ON: Enables addition of the jitter. OFF: Disables addition of the jitter.
#2	Tx Range	Switches the jitter generation range.
#3	Freq.offset	Sets the frequency offset.
#4	Rx Range	Switches the range for reception jitter measurement.
#5	Filter	Enables selection of filter for reception jitter measurement.
#6	Mode	Enables selection of measurement mode. Single: Performs single measurement. Repeat: Automatically starts the next round of measurement after completion of a round of measurement. Manual: Continues measurement until the Start/Stop key is pressed once measurement starts. Sets the measuring time for measurement performed in the single or repeat mode.

4.3 Main Result Screen

4.3.1 Secondary Jitter Screen

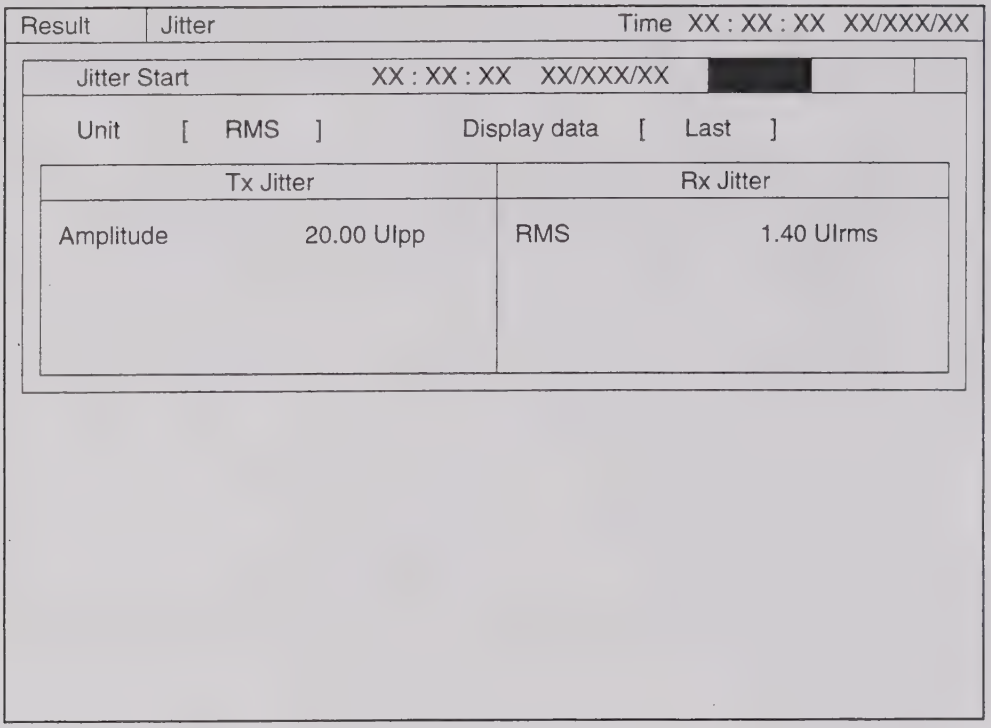
A screen to display the measured results of jitter.

(1) At peak



No.	Display	Description
#1	Display data	Enables selection of the method for measured result display. Current: Displays the results from the measurement start to the present. Last: Displays the results at the completion of measurement.
#2	Unit	Enables selection of the style of data to be displayed. Peak: Displays the peak to peak measured results of the jitter. RMS: Displays the measured results of effective jitter value.
#3	Tx Jitter	Displays the monitor value of transmission jitter amplitude.
#4	Rx Jitter	Peak–Peak displays the peak value of the measured values of the reception jitter in UI_{PP}. +Peak: Displays the +peak value of measured values of the reception jitter in UI+p. –Peak: Displays the –peak value of measured values of the reception jitter in UI–p. RMS displays the effective value of measured values of the reception jitter in UIrms.

(2) RMS


Result
Jitter
Time XX : XX : XX XX/XXX/XX
Jitter Start
XX : XX : XX XX/XXX/XX
Unit [RMS]
Display data [Last]
Tx Jitter
Amplitude 20.00 UIpp
Rx Jitter
RMS 1.40 UIrms

Section 5 Example of Operations

5.1 Block Diagram of Jitter Generation Module 5-2
5.2 Generation of Jitter 5-3
5.2.1 Operation procedures 5-3
5.3 Jitter Measurement 5-5
5.3.1 Operation procedures 5-5

5.1 Block Diagram of Jitter Generation Module

The MP1777A can and add jitter that conform to ITU-T 0.172 Draft to the signal (clock) of the bit rate (clock) coverd by each option 01, 02 or 04.

Figure 5-1 shows a block diagram of the jitter modulation module of the MP1777A. As the MP1777A does not incorporate a modulating signal generator, the modulating signal must be input from an external signal generator.

NOTE:

All the jitter measurement can be automatically performed from an external Personal Computer by combining the MS4630B Network Analyzer and the MX177701A Jitter Performance Test Software.

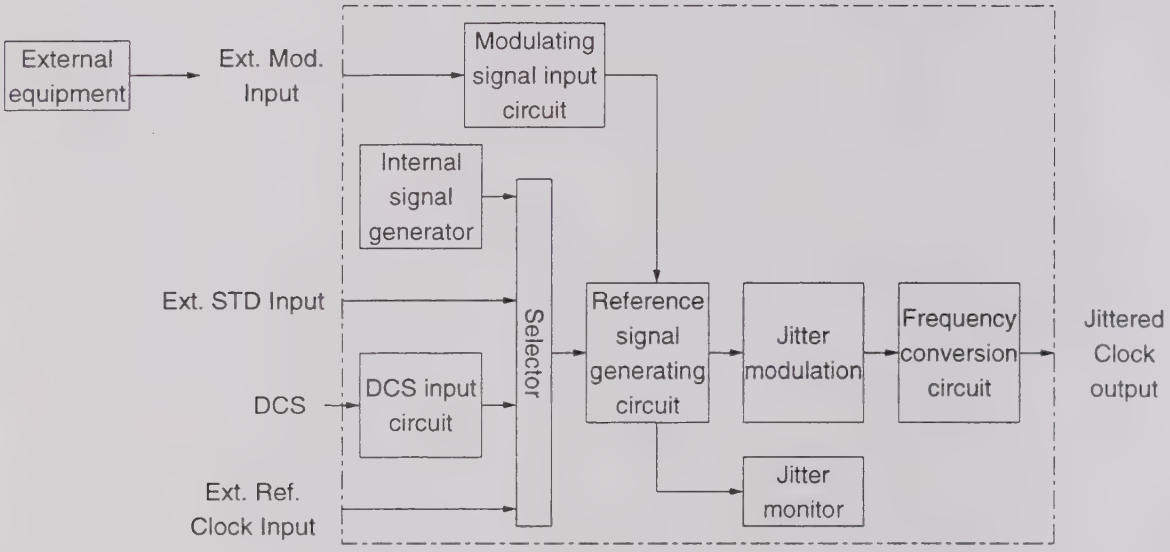


Fig. 5-1 Block Diagram for MP1777A Jitter Generation Module

5.2 Generation of Jitter

5.2.1 Operation procedures

Procedures for jitter generation using external modulating signal source
Example: Bit Rate = 9,953 MHz, Modulation frequency = 100 kHz, Jitter amplitude = 1 UI_{PP}

(1) Connect an external modulating signal generator to Ext. Mod. Input of the MP1777A (See Fig. 5-2).
(Do not input signal exceeding 2 V_{PP}.)

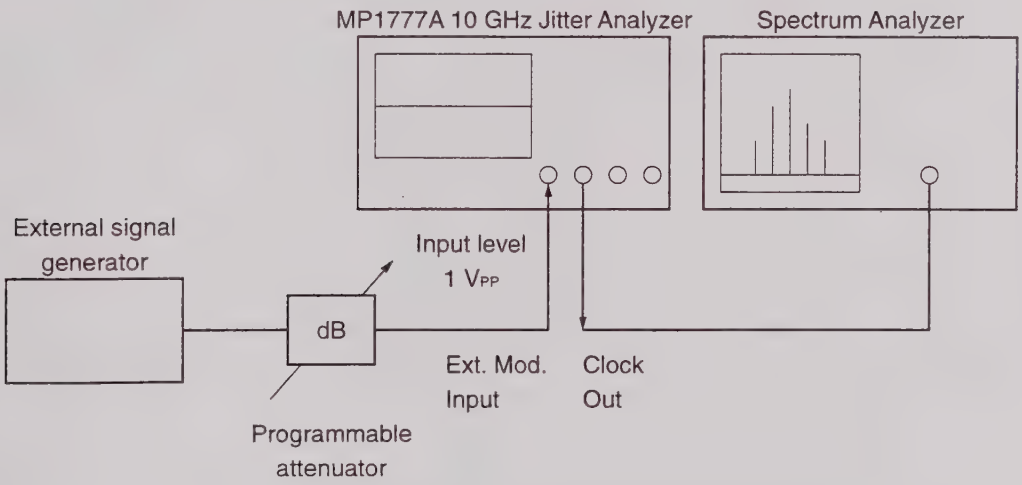


Fig. 5-2 Jitter Generation Configuration

(2) Select Bit Rate = 9,953 M on the secondary screen of the setup menu interface of the MP1777A.
Also, set Jitter Setting/Equalizer = OFF.
(The equalizer is used for automatic measurement of jitter transfer. Normally, select the equalizer setting of OFF.)

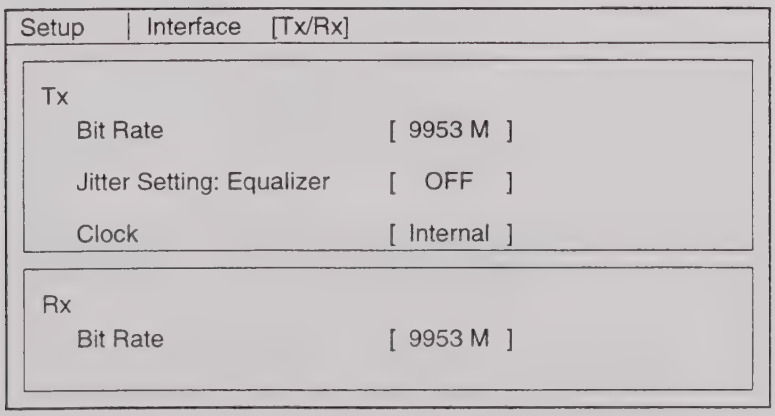


Fig. 5-3 Setup Screen

(3) Set Tx Jitter = ON on the Test menu/manual jitter screen.
Also set Tx Range = 80 UI.

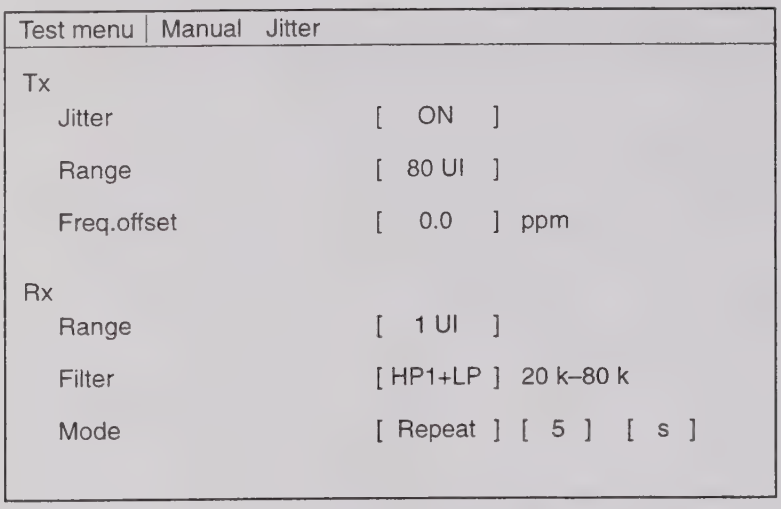


Fig. 5-4 Test Menu Screen (Manual)

(4) A clock with 1 UI jitter can be generated by setting the output level of the external modulating signal so that the TX monitor value on the Result screen becomes 1 UI.

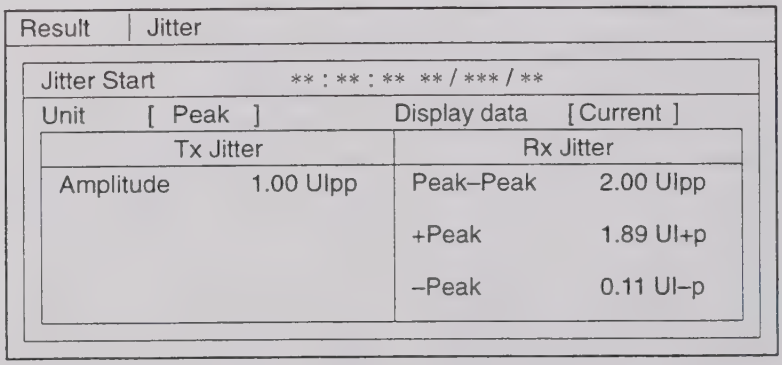

Result | Jitter
Jitter Start ** : ** : ** ** / *** / **
Unit [Peak] Display data [Current]
Tx Jitter
Amplitude 1.00 UIpp
Rx Jitter
Peak–Peak 2.00 UIpp
+Peak 1.89 UI+p
–Peak 0.11 UI–p

Fig. 5-5 Result Screen (Manual)

NOTE:

Refer to the Section 6 "Supplementary Data" for the amount of jitter enabled to be generated on each bit range and range.

5.3 Jitter Measurement

The MP1777A 10 GHz Jitter Analyzer enables measurement of jitter of up to 80 MHz bandwidth, which conforms to ITU-T 0.172 Draft.

5.3.1 Operation procedures

Example:

Measurement of output jitter of bit rate = 9,953 M

(1) Connect the signal (clock) to be measured to the MP1777A 10 GHz Jitter Analyzer.

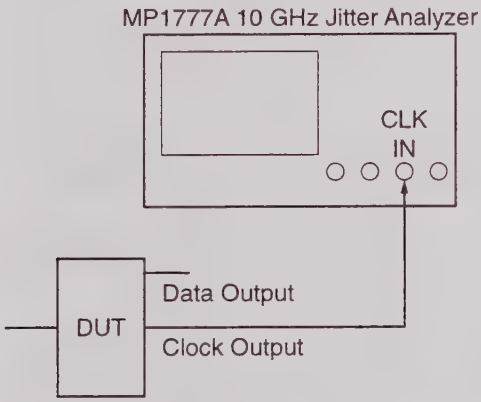


Fig. 5-6 Connection Diagram for Jitter Measurement

(2) Set Rx Bit Rate = 9,953 M on the Setup screen.

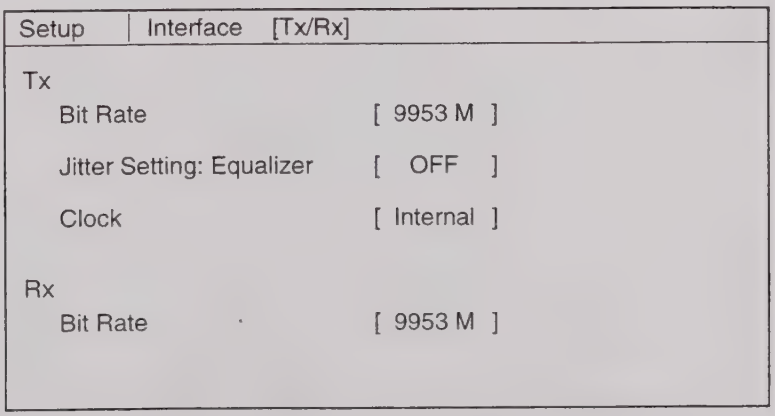


Fig. 5-7 Setup Screen

(3) Set Rx Range = 4 UI and Filter = HP1+LP on the Test menu screen.
Also set Mode = Single and 60 second

Test menu ¦ Manual Jitter		
Tx		
Jitter	[ON]	
Range	[20 UI]	
Freq.offset	[0.0]	ppm
Rx		
Range	[4 UI]	
Filter	[HP1+LP]	10 k–80 k
Mode	[Single] [60]	[s]

Fig. 5-8 Test Menu Screen (Manual)

(4) Pressing the Start/Stop button to start measurement causes the results to be displayed on the Result screen.

Result ¦ Jitter			
Jitter Start	** : ** : ** ** / *** / **		
	Peak		Current
Tx Jitter		Rx Jitter	
Amplitude	1.00 Ulpp	Peak–Peak	1.48 Ulpp
		+Peak	0.74 UI+p
		–Peak	0.74 UI–p

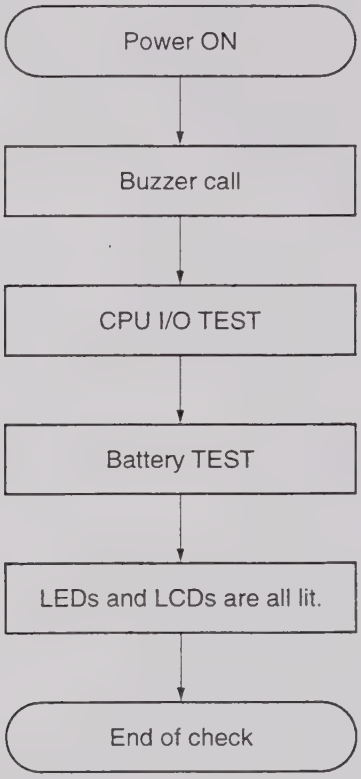
Fig. 5-9 Result Screen (Manual)

Section 6 Performance Tests

6.1 Checking CPU and Peripheral Devices 6-2
6.2 Checking Clock Output Level 6-3
6.3 Checking External Modulation Input Sensitivity 6-4
6.4 Checking Jitter Measurement Accuracy 6-5
6.5 Checking Demod. Output Sensitivity 6-7

6.1 Checking CPU and Peripheral Devices

The MP1777A checks the CPU and the peripheral devices in the following sequence when the power is turned on.



6.2 Checking Clock Output Level

Check the output level in the following sequence.

(1) Connect the MP1777A 10 GHz Jitter Analyzer and the Spectrum Analyzer as shown in Fig. 6-1.
(2) Set the Bit Rate to 9953M on the "Setup: Interface" screen.
(3) Set the Tx Jitter = OFF on the "Test menu: Manual" screen.
(4) Adjust the Spectrum Analyzer sensor frequency to 9953.28 MHz.
(5) Check that the output level satisfies +5 dBm ±3 dB.
(6) Change the Bit Rate on the "Setup: Interface" screen, and repeat 1 to 5.

NOTE:

Refer to Table 6-1 to set the Bit Rate and the Spectrum Analyzer sensor frequency on the Setup menu.

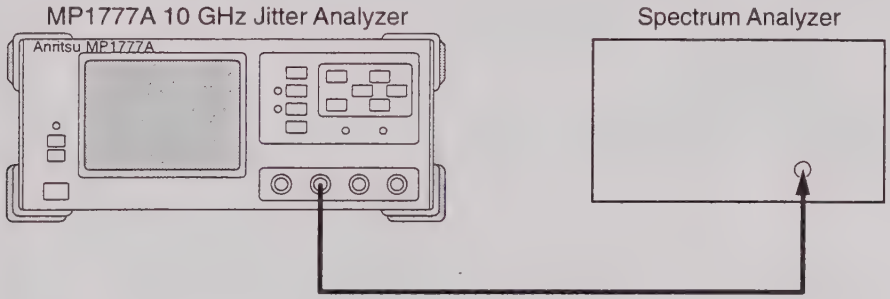


Fig. 6-1 Clock Output Level Performance Test

Table 6-1 Nominal Frequency for Each Bit Rate

	Bit Rate	Nominal frequency
Standard	2488 M	2488.32 MHz
	4977 M	4976.64 MHz
	9953 M	9953.28 MHz
Option 01	2494 M	2494.16 MHz
	4988 M	4988.32 MHz
	9976 M	9976.64 MHz
Option 02	2666 M	2666.0571 MHz
	5332 M	5332.1142 MHz
	10664 M	10664.2284 MHz
Option 04	3062 M	3062.3629 MHz
	6125 M	6124.7259 MHz
	12249 M	12249.4517 MHz

6.3 Checking External Modulation Input Sensitivity

Check the external modulation input sensitivity in the following sequence.

(1) Connect the MP1777A 10 GHz Jitter Analyzer and the Signal Generator as shown in Fig. 6-2.
(2) Set the Bit Rate to 9953M on the "Setup: Interface" screen.
(3) Set the Tx Jitter = ON and the Range = 0.5 UI on the "Test menu: Manual Jitter" screen.
(4) From the Signal Generator, enter the sine wave signals with frequency 100 kHz and level 0.5 V_{PP} to Ext. Mod. Input of the MP1777A.
(5) Check that the Tx monitor on the "Result/Jitter" screen satisfies the standard in Table 6-2.
(6) Change the Bit Rate on the "Setup: Interface" screen. By referring to Table 6-2, repeat 1 to 5 to check the sensitivity.

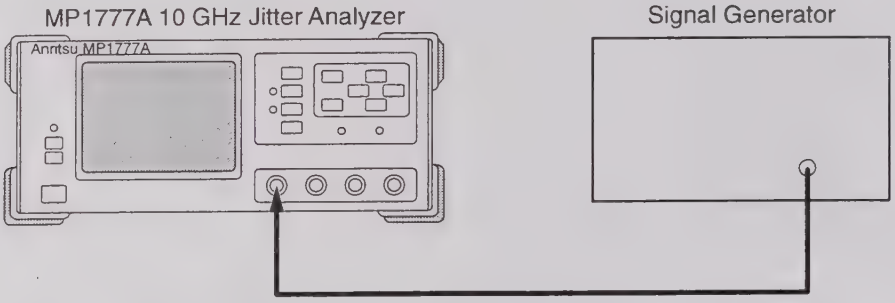


Fig. 6-2 External Modulation Input Sensitivity Performance Test

Table 6-2 External Modulation Input Sensitivity Threshold Values

Bit Rate	Range	Minimum value (UI_{PP})	Maximum value (UI_{PP})	Standard
2488 M	0.5 UI	0.425	0.575	0.5 UI_{PP} ± 15 %/2 V_{PP}
2494 M	20 UI	17	23	20 UI_{PP} ± 15 %/1 V_{PP}
2666 M	800 UI	680	920	800 UI_{PP} ± 15 %/1 V_{PP}
4977 M	0.5 UI	0.425	0.575	0.5 UI_{PP} ± 15 %/1 V_{PP}
4988 M	40 UI	34	46	40 UI_{PP} ± 15 %/1 V_{PP}
5332 M	1600 UI	1360	1840	1600 UI_{PP} ± 15 %/1 V_{PP}
9953 M	0.5 UI	0.425	0.575	0.5 UI_{PP} ± 15 %/0.5 V_{PP}
9976 M	80 UI	68	92	80 UI_{PP} ± 15 %/1 V_{PP}
10664 M	3200 UI	2720	3680	3200 UI_{PP} ± 15 %/1 V_{PP}
3062M	0.5 UI	0.425	0.575	0.5 UI_{PP} ± 15 %/1.5 V_{PP}
	20 UI	17	23	20 UI_{PP} ± 15 %/1 V_{PP}
	800 UI	680	920	800 UI_{PP} ± 15 %/1 V_{PP}
6125M	0.5 UI	0.425	0.575	0.5 UI_{PP} ± 15 %/0.75 V_{PP}
	40 UI	34	46	40 UI_{PP} ± 15 %/1 V_{PP}
	1600 UI	1360	1840	1600 UI_{PP} ± 15 %/1 V_{PP}
12249M	0.5 UI	0.425	0.575	0.5 UI_{PP} ± 15 %/0.375 V_{PP}
	80 UI	68	92	80 UI_{PP} ± 15 %/1 V_{PP}
	3200 UI	2720	3680	3200 UI_{PP} ± 15 %/1 V_{PP}

6.4 Checking Jitter Measurement Accuracy

Check the Jitter measurement accuracy in the following sequence.

(1) Connect the MP1777A 10 GHz Jitter Analyzer and the Signal Generator as shown in Fig. 6-3.
(2) Set the Bit Rate to 9953M on the "Setup: Interface" screen.
(3) Set the TX Jitter = ON and the Freq. Offset = 0.0 ppm on the "Test menu: Manual Jitter" screen.
(4) Set the Range = 0.5 UI on the "Test menu: Manual Jitter" screen.
(5) Enter the sign wave signals of 100 kHz frequency from the external signal generator. Adjust the amplitude of the Signal Generator so that the Tx monitor on the "Result/Jitter" screen is set to 0.5 UI_{PP}.
(6) Set the Rx Range = 1 UI and the Filter = HP1 + LP on the "Test menu: Manual Jitter" screen.
(7) Check that the value of the Rx Jitter Peak–Peak on the "Result: Jitter" screen satisfies the standard in Table 6-3-1.
(8) Set the Rx Range = 1 UI and the Filter = HP + LP on the "Test menu: Manual Jitter" screen.
(9) Check that the value of the Rx Jitter rms on the "Result: Jitter" screen satisfies the standard in Table 6-3-2.
(10) Change the Bit Rate on the "Setup: Interface" screen, and repeat 1 to 9 to check the accuracy.

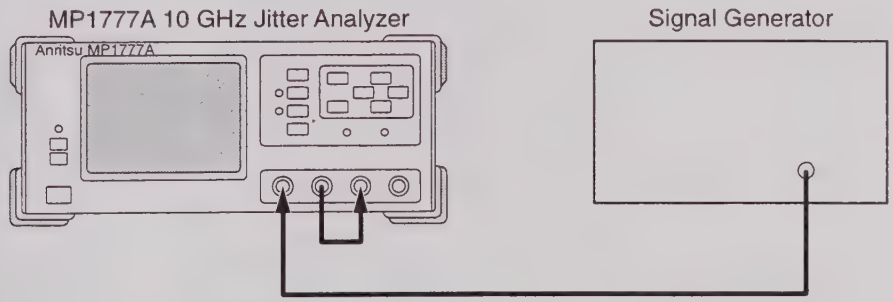


Fig. 6-3 Jitter Measurement Accuracy Performance Test

Table 6-3-1 Jitter Measurement Accuracy Threshold Values (UI_{PP})

Bit Rate	Range	Minimum value (UI_{PP})	Maximum value (UI_{PP})	Standard (UI_{PP})
2488 M 2494 M	1 UI	0.425	0.575	±5 % ± 0.05 UI_{PP} (with HP1 + LP)
2666 M 3062 M	4 UI	0.26	0.74	±5 % ± 0.22 UI_{PP} (with HP1 + LP)
4977 M 4988 M	1 UI	0.423	0.577	±5 % ± 0.07 UI_{PP} (with HP1 + LP)
5332 M 6125 M	4 UI	0.24	0.76	±5 % ± 0.24 UI_{PP} (with HP1 + LP)
9953 M 9976 M	1 UI	0.421	0.579	±5 % ± 0.09 UI_{PP} (with HP1 + LP)
10664 M 12249 M	4 UI	0.22	0.78	±5 % ± 0.26 UI_{PP} (with HP1 + LP)

Table 6-3-2 Jitter Measurement Accuracy Threshold Values (UIrms)

Bit Rate	Range	Minimum value (UIrms)	Maximum value (UIrms)	Standard (UIrms)
2488 M 2494 M	1 UI	0.163	0.191	±5 % ± 0.008 UIrms (with HP + LP)
2666 M 3062 M	4 UI	0.10	0.26	±5 % ± 0.08 UIrms (with HP + LP)
4977 M 4988 M	1 UI	0.162	0.192	±5 % ± 0.009 UIrms (with HP + LP)
5332 M 6125 M	4 UI	0.09	0.27	±5 % ± 0.09 UIrms (with HP + LP)
9953 M 9976 M	1 UI	0.161	0.193	±5 % ± 0.01 UIrms (with HP + LP)
10664 M 12249 M	4 UI	0.08	0.28	±5 % ± 0.1 UIrms (with HP + LP)

6.5 Checking Demod. Output Sensitivity

Check the Demod. Output sensitivity in the following sequence.

(1) Connect the MP1777A 10 GHz Jitter Analyzer, the Signal Generator and the Oscilloscope as shown in Fig. 6-4.
(2) Set the Bit Rate to 9953M on the "Setup: Interface" screen.
(3) Set the Tx Jitter = ON and the Range = 80 UI on the "Test menu: Manual Jitter" screen.
(4) Set the Rx Range = 1 UI and the Filter = HP1 + LP on the "Test menu: Manual Jitter" screen.
(5) Enter the sine wave signals of 100 kHz frequency from the external signal generator. Adjust the amplitude of the Signal Generator so that the Rx monitor on the "Result/Jitter " screen is set to 1.000 UI_{PP}.
(6) Check the Demod. Output using the Oscilloscope. Check that the value satisfies the standard in Table 6-4.
(7) Change the Bit Rate on the "Setup: Interface" screen, and repeat 1 to 6 to check the sensitivity.

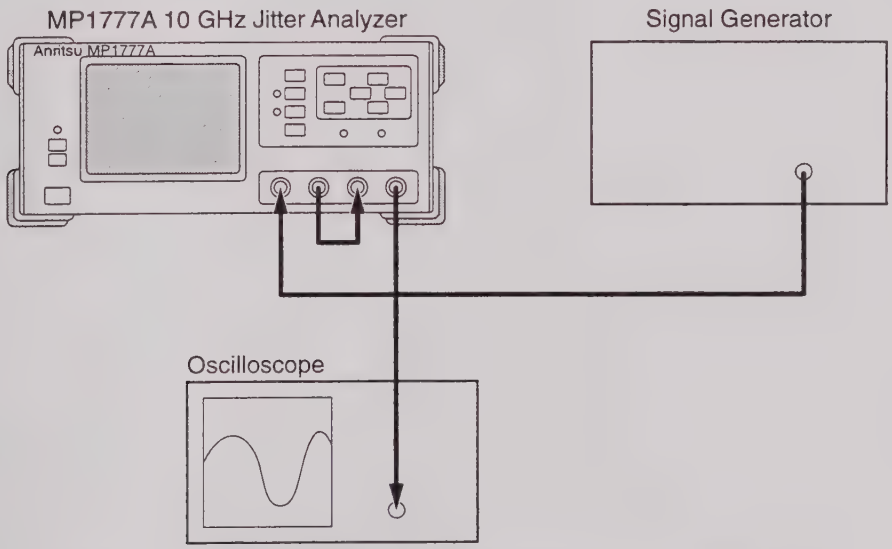


Fig. 6-4 "Demod. Output" Output Sensitivity Performance Test

Table 6-4 "Demod. Output" Output Sensitivity Performance Test Threshold Values

Bit Rate	Range	Minimum value (V_{PP})	Maximum value (V_{PP})	Standard
2488 M 2494 M	1 UI	0.85	1.15	1 V_{PP} ± 15 %/1 UI_{PP}
2666 M 3062 M	4 UI	0.85	1.15	1 V_{PP} ± 15 %/4 UI_{PP}
4977 M 4988 M	1 UI	0.85	1.15	1 V_{PP} ± 15 %/1 UI_{PP}
5332 M 6125 M	4 UI	0.85	1.15	1 V_{PP} ± 15 %/4 UI_{PP}
9953 M 9976 M	1 UI	0.85	1.15	1 V_{PP} ± 15 %/1 UI_{PP}
10664 M 12249 M	4 UI	0.85	1.15	1 V_{PP} ± 15 %/4 UI_{PP}

Section 7 Storage and Transportation

7.1 Daily Maintenance 7-2
7.2 Storage 7-2
7.2.1 Precaution on storage 7-2
7.2.2 Recommended Storage Conditions 7-2
7.3 Transportation 7-2

7.1 Daily Maintenance

Table 7-1 shows the procedure and time for daily maintenance.

Table 7-1 Daily Maintenance

Item	Time	Procedure
Stained outer surfaces	• Before long-time storage • After using in a dusty place • When a foreign matter is involved • When dust is involved	Wipe using cloth moistened with diluted neutral detergent.
Adhered dust and dirt		Clean using an electric cleaner. When cleaning a fan, do not vacuum the air too hard.
Loosened screws	• Whenever a loosenedscrew is found	Tighten it using a suitable tool.

7.2 Storage

7.2.1 Precaution on storage

Be sure to observe the following points when storing for a long time.

(1) Wipe off dust and dirt adhered on the analyzer before storage.
(2) Avoid storing the analyzer in a place where the temperature may rise higher than +60 or lower below –20 degrees centigrade or a place where humidity may rise higher than 75 % or lower below 20 %.
(3) Avoid storing the analyzer for a long period of time in a place subject to direct sunlight or a dusty place.
(4) Avoid storing the analyzer in a place possibly exposed to dew condensation, active gas or acid.

7.2.2 Recommended Storage Conditions

When storing the analyzer for a long time, the storage place must meet the conditions in 7.2.1. In addition, the following storage conditions are also recommended:

- Temperature: 5 to 30 °C
- Humidity: 40 % to 75 %
- Daily fluctuation of temperature and humidity is small.

7.3 Transportation

Observe the following points when transporting the analyzer.

(1) Attach a protective cover to the front of the MP1777A.
(2) To protect the analyzer from moisture, shocks and vibration, put it in a vinyl bag, and then put it in a corrugated cardboard box filled with cushioning material.
(3) During the transportation, place the analyzer in an environment which meets the conditions in 7.2.1.

Section 8 Supplementary Data

8.1 Jitter Amplitude Limit 8-2

8.1 Jitter Amplitude Limit

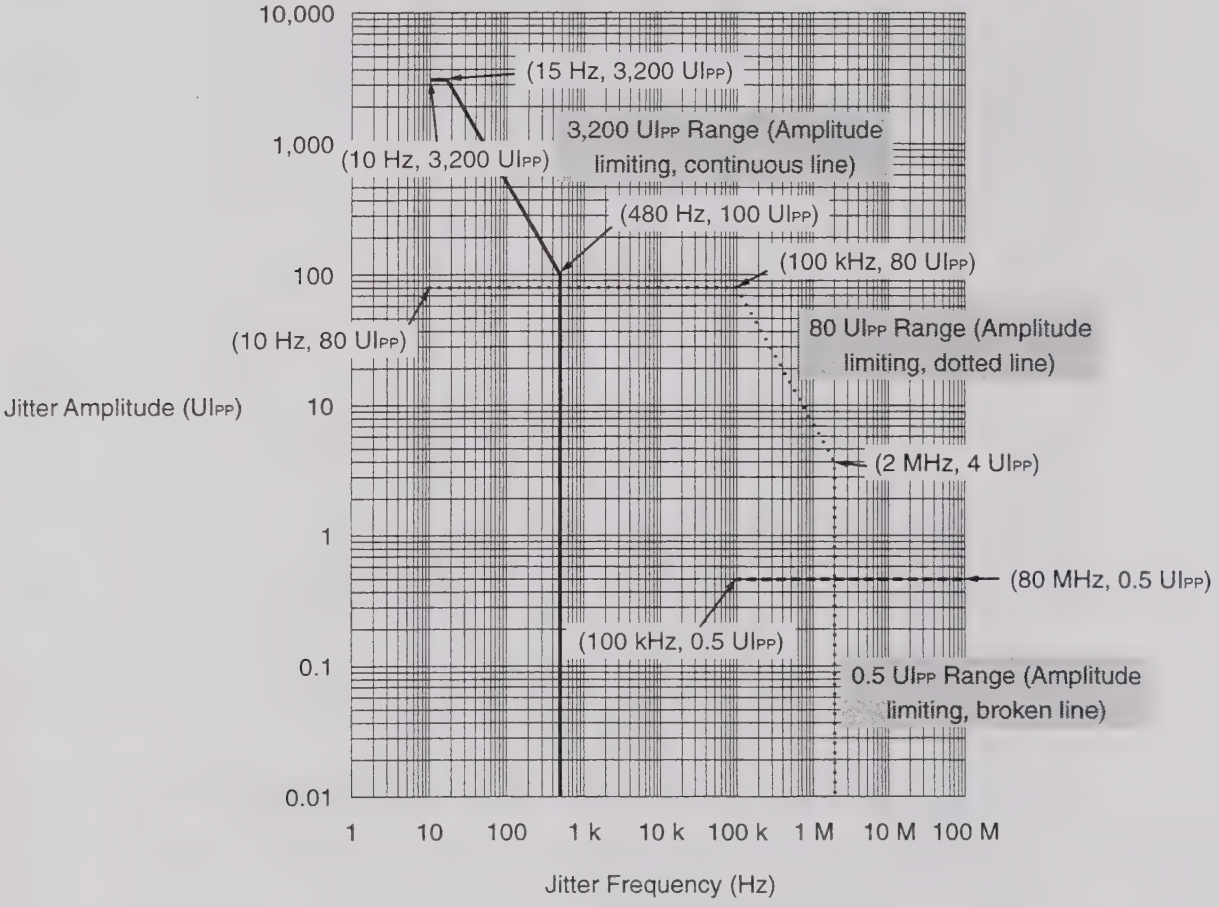


Fig. 8-1 MP1777A 10 Gbit/s Jitter Amplitude Limiting

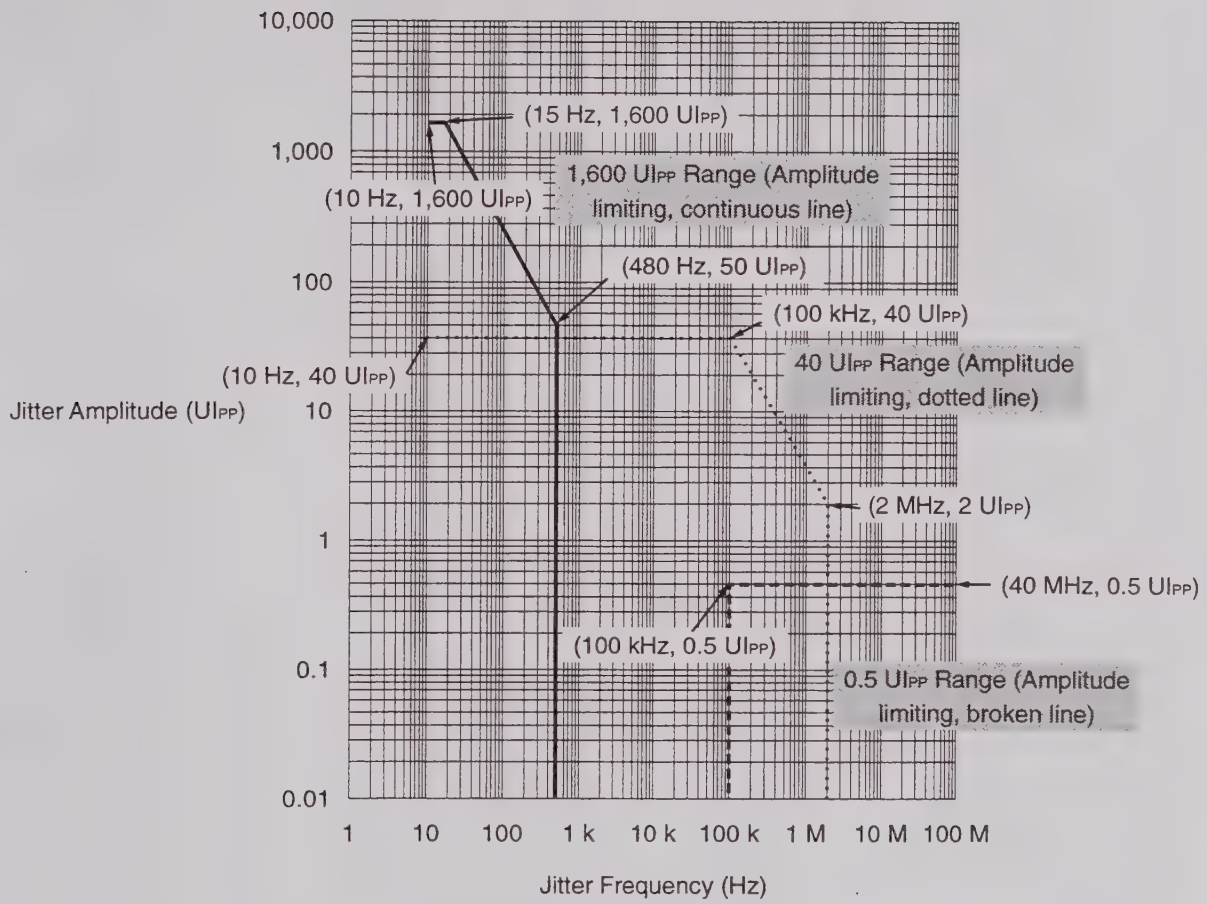


Fig. 8-2 MP1777A 5 Gbit/s Jitter Amplitude Limiting

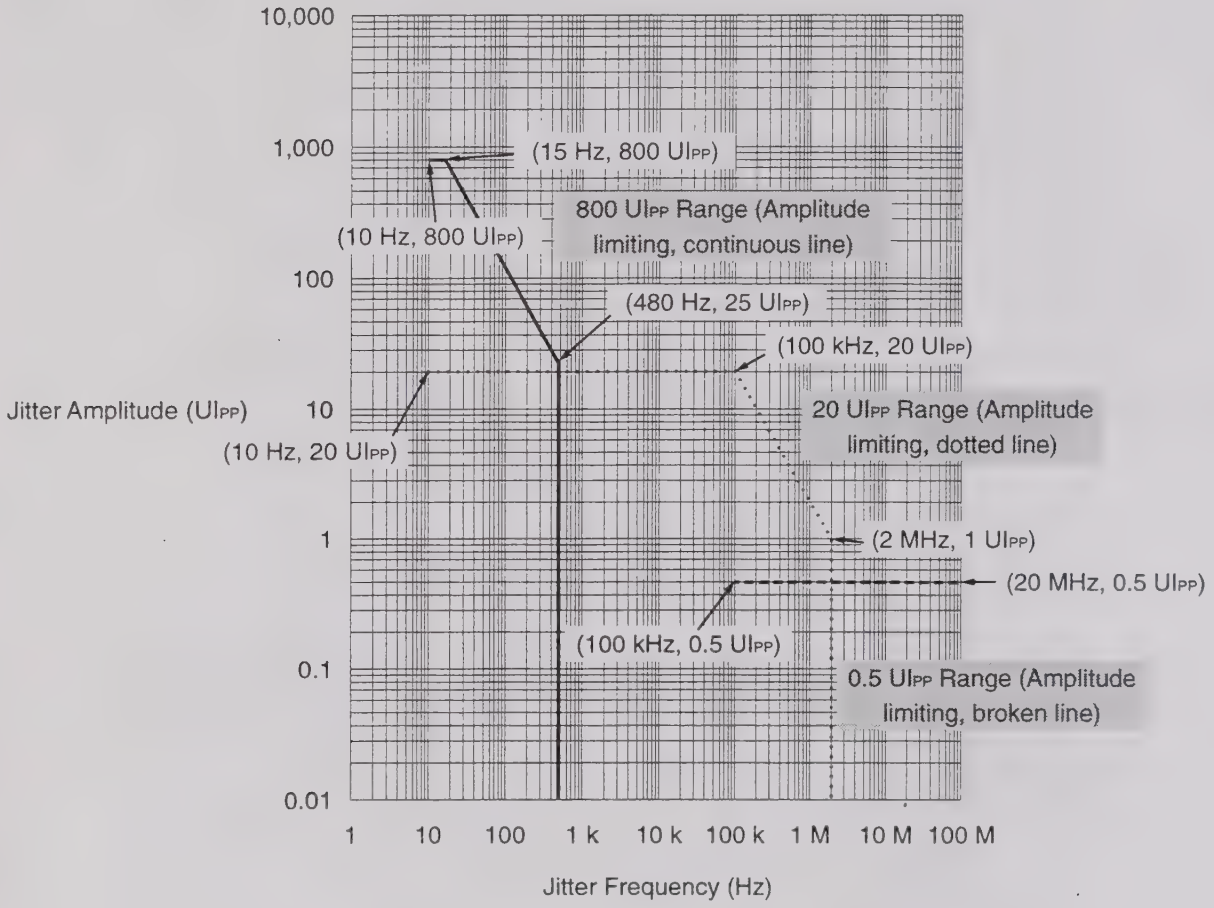


Fig. 8-3 MP1777A 2.5 Gbit/s Jitter Amplitude Limiting

Appendix A
Performance Test Results Entry Table

Test site _____ Report No. _____

_____ Date _____

_____ Person in charge of the test _____

Analyzer name: MP1777A 10 GHz Jitter Analyzer

Manufacturing No. _____ Ambient temperature _____ °C

Power supply frequency _____ Hz Relative temperature _____ %

Remarks:

_____

_____

_____

_____

_____

_____

MP1777A 10 GHz Jitter Analyzer No. _____ Date _____

Test name [Clock output level]	Minimum specification value	Result	Maximum specification value	Measurement uncertainty
2488 M	+2 dBm		+8 dBm	±0.4 dB
2494 M	+2 dBm		+8 dBm	
2666 M	+2 dBm		+8 dBm	
3062 M	+2 dBm		+8 dBm	
4977 M	+2 dBm		+8 dBm	
4988 M	+2 dBm		+8 dBm	
5332 M	+2 dBm		+8 dBm	
6125 M	+2 dBm		+8 dBm	
9953 M	+2 dBm		+8 dBm	
9976 M	+2 dBm		+8 dBm	
10664 M	+2 dBm		+8 dBm	
12249 M	+2 dBm		+8 dBm	

Appendix A Performance Test Results Entry Table

Test name [External modulation input sensitivity]	Minimum specification value	Result	Maximum specification value	Measurement uncertainty
2488 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
2488 M/20 UI	17 UI_{PP}		23 UI_{PP}	
2488 M/800 UI	680 UI_{PP}		920 UI_{PP}	
2494 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
2494 M/20 UI	17 UI_{PP}		23 UI_{PP}	
2494 M/800 UI	680 UI_{PP}		920 UI_{PP}	
2666 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
2666 M/20 UI	17 UI_{PP}		23 UI_{PP}	
2666 M/800 UI	680 UI_{PP}		920 UI_{PP}	
3062 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
3062 M/20 UI	17 UI_{PP}		23 UI_{PP}	
3062 M/800 UI	680 UI_{PP}		920 UI_{PP}	
4977 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
4977 M/40 UI	34 UI_{PP}		46 UI_{PP}	
4977M/1600 UI	1360 UI_{PP}		1840 UI_{PP}	
4988 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
4988 M/40 UI	34 UI_{PP}		46 UI_{PP}	
4988 M/1600 UI	1360 UI_{PP}		1840 UI_{PP}	
5332 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
5332 M/40 UI	34 UI_{PP}		46 UI_{PP}	
5332 M/1600 UI	1360 UI_{PP}		1840 UI_{PP}	
6125 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
6125 M/40 UI	34 UI_{PP}		46 UI_{PP}	
6125 M/1600 UI	1360 UI_{PP}		1840 UI_{PP}	
9953 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
9953 M/80 UI	68 UI_{PP}		92 UI_{PP}	
9953 M/3200 UI	2720 UI_{PP}		3680 UI_{PP}	
9976 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
9976 M/80 UI	68 UI_{PP}		92 UI_{PP}	
9976 M/3200 UI	2720 UI_{PP}		3680 UI_{PP}	
10644 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
10664 M/80 UI	68 UI_{PP}		92 UI_{PP}	
10664 M/3200 UI	2720 UI_{PP}		3680 UI_{PP}	
12249 M/0.5 UI	0.425 UI_{PP}		0.575 UI_{PP}	
12249 M/80 UI	68 UI_{PP}		92 UI_{PP}	
12249 M/3200 UI	2720 UI_{PP}		3680 UI_{PP}	

Test name [Jitter measurement accuracy] (UI_{PP})	Minimum specification value	Result	Maximum specification value	Measurement uncertainty
2488 M/1 UI	0.425 UI_{PP}		0.575 UI_{PP}	
2488 M/4 UI	0.26 UI_{PP}		0.74 UI_{PP}	
2494 M/1 UI	0.425 UI_{PP}		0.575 UI_{PP}	
2494 M/4 UI	0.26 UI_{PP}		0.74 UI_{PP}	
2666 M/1 UI	0.425 UI_{PP}		0.575 UI_{PP}	
2666 M/4 UI	0.26 UI_{PP}		0.74 UI_{PP}	
3062 M/1 UI	0.425 UI_{PP}		0.575 UI_{PP}	
3062 M/4 UI	0.26 UI_{PP}		0.74 UI_{PP}	
4977 M/1 UI	0.423 UI_{PP}		0.577 UI_{PP}	
4977 M/4 UI	0.24 UI_{PP}		0.76 UI_{PP}	
4988 M/1 UI	0.423 UI_{PP}		0.577 UI_{PP}	
4988 M/4 UI	0.24 UI_{PP}		0.76 UI_{PP}	
5332 M/1 UI	0.423 UI_{PP}		0.577 UI_{PP}	
5332 M/4 UI	0.24 UI_{PP}		0.76 UI_{PP}	
6125 M/1 UI	0.423 UI_{PP}		0.577 UI_{PP}	
6125 M/4 UI	0.24 UI_{PP}		0.76 UI_{PP}	
9953 M/1 UI	0.421 UI_{PP}		0.579 UI_{PP}	
9953 M/4 UI	0.22 UI_{PP}		0.78 UI_{PP}	
9976 M/1 UI	0.421 UI_{PP}		0.579 UI_{PP}	
9976 M/4 UI	0.22 UI_{PP}		0.78 UI_{PP}	
10664 M/1 UI	0.421 UI_{PP}		0.579 UI_{PP}	
10664 M/4 UI	0.22 UI_{PP}		0.78 UI_{PP}	
12249 M/1 UI	0.421 UI_{PP}		0.579 UI_{PP}	
12249 M/4 UI	0.22 UI_{PP}		0.78 UI_{PP}	

Test name [Jitter measurement accuracy] (UIrms)	Minimum specification value	Result	Maximum specification value	Measurement uncertainty
2488 M/1 UI	0.163 UIrms		0.191 UIrms	
2488 M/4 UI	0.10 UIrms		0.26 UIrms	
2494 M/1 UI	0.163 UIrms		0.191 UIrms	
2494 M/4 UI	0.10 UIrms		0.26 UIrms	
2666 M/1 UI	0.163 UIrms		0.191 UIrms	
2666 M/4 UI	0.10 UIrms		0.26 UIrms	
3062 M/1 UI	0.163 UIrms		0.191 UIrms	
3062 M/4 UI	0.10 UIrms		0.26 UIrms	
4977 M/1 UI	0.162 UIrms		0.192 UIrms	
4977 M/4 UI	0.09 UIrms		0.27 UIrms	
4988 M/1 UI	0.162 UIrms		0.192 UIrms	
4988 M/4 UI	0.09 UIrms		0.27 UIrms	
5332 M/1 UI	0.162 UIrms		0.192 UIrms	
5332 M/4 UI	0.09 UIrms		0.27 UIrms	
6125 M/1 UI	0.162 UIrms		0.192 UIrms	
6125 M/4 UI	0.09 UIrms		0.27 UIrms	
9953 M/1 UI	0.161 UIrms		0.193 UIrms	
9953 M/4 UI	0.08 UIrms		0.28 UIrms	
9976 M/1 UI	0.161 UIrms		0.193 UIrms	
9976 M/4 UI	0.08 UIrms		0.28 UIrms	
10664 M/1 UI	0.161 UIrms		0.193 UIrms	
10664 M/4 UI	0.08 UIrms		0.28 UIrms	
12249 M/1 UI	0.161 UIrms		0.193 UIrms	
12249 M/4 UI	0.08 UIrms		0.28 UIrms	

Appendix A Performance Test Results Entry Table

Test name [Demod. Out] Output sensitivity	Minimum specification value	Result	Maximum specification value	Measurement uncertainty
2488 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
2488 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
2494 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
2494 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
2666 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
2666 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
3062 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
3062 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
4977 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
4977 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
4988 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
4988 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
5332 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	±1.1 %
5332 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
6125 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
6125 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
9953 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
9953 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
9977 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
9977 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
10664 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
10664 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	
12249 M/1 UI	0.85 V_{PP}		1.15 V_{PP}	
12249 M/4 UI	0.85 V_{PP}		1.15 V_{PP}	

Part Number (Name, QTY, Description)	Voltage	Result	Notes

MP MASTER
MA35035